Perinatal sleep and postnatal mood in New Zealand women:

An investigation of the relationship and
trial of a sleep education intervention

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This thesis is dedicated to all mothers.

Kia kaha e whae[1]

Be brave, O Mother

And especially to my own mother,

Deirdre Bernadette Sweeney

19 October 1929 to 21 March 2014

[1] Words of encouragement expressed by birth attendants to birthing Māori women, from The Old-Time Māori, by Makereti, 1938, Victor Gollancz Limited, London. Source: National Library of New Zealand.

Abstract

Changes to normal sleep are experienced by almost all women in pregnancy and the postnatal period. Little is known about the frequency, magnitude or chronicity of these changes, or the relationship between perinatal sleep and postnatal mood. Two studies were completed to investigate these relationships and to trial a sleep education intervention.

Study One involved 316 Māori and 635 non-Māori women. Women completed sleep and health surveys during the third trimester of pregnancy, at 4-6 weeks and 12 weeks postpartum. On average, sleep duration and quality were highest before pregnancy, lowest in late pregnancy and did not return to usual, non-pregnant levels by 3 months postpartum. Symptoms of minor and major depression, measured using the Edinburgh Postnatal Depression Scale, were more common in pregnancy (35.6% minor, 16.5% major depression) than at 3 months postpartum (16.3% minor, 7.8% major depression). Hierarchical regression models were used to investigate the relationship between sleep and postnatal mood. After controlling for demographics and known risk factors, both sleep quality and quantity were related to postnatal depression, especially when sleep continued to decline after birth and the magnitude of sleep change was large. Difficulty falling asleep, staying asleep, and restless legs syndrome were all also related to postnatal depression.

Study Two was a controlled trial of a behavioural-educational sleep intervention for first-time mothers. Control group mothers (n=20) attended a prenatal, general information session and received two contact-only telephone calls at 2 and 4 weeks postpartum. Intervention group mothers, (n=20) attended a prenatal sleep education session and received weekly support calls in the first 6 weeks postpartum. All mothers completed sleep and health questionnaires. Sleep was objectively measured in all mother-infant pairs at 6 and 12 weeks postpartum using actigraphy. Intervention group mothers experienced a greater increase in sleep at night than control mothers, and reported higher levels of confidence, but no other group differences were found. Replication of the intervention and extension of the study timeframe are recommended.

These findings indicate the importance of sleep for maternal health and have implications for the practice of health professionals and maternal health policy.

Preface

E Moe, Māmā: sleep mother, go to sleep mother

Hapu Ora: health in pregnancy

Hauora Hinengaro: mental health

PIPIS: Parent information on Parent and Infant Sleep

A play on words…

Pēpe: baby

Pipi: a small edible clam, endemic to New Zealand

Pīpī: a young chick

This thesis comprises two studies which sit within the scope of a multi-study Health Research Council of New Zealand funded research project known as *E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand,* or *The E Moe, Māmā Project*. In total, 1,226 women (Māori = 424, non-Māori = 802) participated in various aspects of The E Moe, Māmā Project and the aims of the total project were:

1. To investigate the relationship between sleep duration and quality during the third trimester of pregnancy and labour and birth outcomes. That study, known as *E Moe, Māmā: Hapu Ora,* does not fall within the scope of the current thesis.
2. To investigate the relationship between sleep duration and quality during late pregnancy and early postpartum and changes in postpartum mood. This study, known as *E Moe, Māmā: Hauora Hinengaro,* forms Study One of the current thesis.
3. To trial a sleep education intervention aimed at improving the sleep of new mothers and their infants. This study is known as the *Parent Information on Parent and Infant Sleep* or *PIPIS Study*, and it forms Study Two of the current thesis.

My approach to undertaking this work has been informed, in part, by 20 years' experience as a childbirth and parent educator, and this explains the anecdotal comments and evidence which are put forward from time to time in the text.

My involvement in this programme of research at the Sleep/Wake Research Centre, Massey University, began six years ago, firstly as an honours student and latterly as a doctoral candidate. The current project was preceded by a successful feasibility study to trial the survey instruments and research processes used in the large-scale survey study.

Data for the E Moe, Māmā: Hapu Ora and E Moe, Māmā: Hauora Hinengaro studies were collected in a single, large-scale, longitudinal survey study, which is described in more detail in the Methods section of Study One. I was involved in almost every aspect of the large-scale study. Specifically I contributed to the funding and ethics applications, questionnaire design, development and production, relationship building with recruitment sites, direct participant recruitment, database construction, data collection and entry, as well as a range of activities aimed at building and maintaining networks and providing education about perinatal sleep. A list of outputs and activities carried out during my doctoral candidature can be found in Appendix 1. While I have contributed at every level to the whole E Moe, Māmā Project, my role was within a wider team who also contributed in similar ways to this complex project. However, the analyses, findings and discussion which follow are my own work.

Study Two describes the PIPIS Study, which was a small-scale trial of a behavioural-educational intervention for first-time mothers, aimed at improving their own and their infant's sleep during the first three months postpartum. Responsibility for design and implementation of the PIPIS study was my own.

Statistical guidance was sought in relation to a range of potential approaches to modelling the data in this study and assistance was given to prepare some of the data for analyses and to write some of the programming code used, however, I completed all statistical analyses and modelling reported here.

The cultural context of this research

New Zealand is a bicultural society (founded on a Treaty between indigenous Maori and English settlers) and health research reflects this duality—drawing on both Western and indigenous methodologies. New Zealand does not have a constitution bound together in a single document. The constitution by which New Zealand is governed comprises a number of pieces of legislation and constitutional elements which include the Treaty of Waitangi (Department of the Prime Minister and Cabinet, 2008; New Zealand Government, n.d.). The Treaty of Waitangi is a treaty of cessation, signed in 1840 by Māori and the British Crown who wished to establish a government in New Zealand. Since it was signed, much debate has ensued about both the original intent of the document (broadly

described as to uphold the interests of both parties) and neglect by successive governments to materialise the treaty expectations of Māori, including for their health (Kingi, 2007). Attempts to bring redress to this situation began for the health sector in 2000 when new health and disability legislation (New Zealand Public Health and Disability Act, 2000) came into being. This Act is the first piece of social policy legislation to reference the Treaty of Waitangi.

A number of principles underpin The Treaty of Waitangi, and Government departments, such as the Ministry of Health, directly reference these principles in their strategic plans. Though by no means an exclusive list, three common principles regularly referenced are: Partnership—working together with Māori communities to develop strategies for Māori health gain and appropriate health and disability services; Participation—involving Māori at all levels of the sector, in decision-making, planning, development and delivery of health and disability services; and Protection—working to ensure that Māori have at least the same level of health as non-Māori as well as safe-guarding Māori cultural concepts, values and practices (Ministry of Health, 2002a).

Ethnic disparities in health are widely reported in the literature (e.g. Baker et al., 2012; Williams, 2002). It has been argued that although disparities are seen to exist, understanding the mechanisms that lead to differences, as well as inconsistencies in the research methodologies applied, means such disparities are poorly understood (Paine & Gander, 2013). Māori make up 15.4% of this country's total population of approximately 4.5 million people. Māori are one of the faster growing populations groups in New Zealand, with projected population growth of 1.3% per year, compared to the 'European or other' population group, which has a growth rate 0.4% per year (Statistics New Zealand, 2010).

On average, Māori have the poorest health status, including sleep health and mental health, of any ethnic group in New Zealand (Ministry of Health, 2002a, 2006). For instance, large scale epidemiological studies have shown that Māori are more likely than non-Māori to obtain insufficient sleep, report higher rates of excessive daytime sleepiness and symptoms of insomnia (Paine & Gander, 2013) and be at increased risk of developing a sleep related breathing disorder (Mihaere et al., 2009). Evidence of differences in the occurrence of mental health disorders between Māori and non-Māori are also unequivocal, with the twelve month prevalence of any mental health disorder for Māori being 29.5% compared to 19.3% for non-Māori (Ministry of Health, 2006). Anxiety disorders are the most commonly reported (19.4% for Māori, 14.1% for non-Māori) followed by any mood disorders (11.6% for Māori, 7.5% for non-Māori). The lifetime prevalence of any mental health disorder is highest in Māori aged 25-44 years (58.1%), and females (52.7%); thus it

is Māori women of childbearing age who carry the highest burden of mental health disease (Ministry of Health, 2006).

For more than a decade, the Sleep/Wake Research Centre has worked in collaboration with researchers from Te Rōpū Rangahau Hauora a Eru Pōmare (University of Otago, Wellington) on a programme of epidemiological sleep research, with a particular focus on identifying disparities in the prevalence of sleep problems between Māori and non-Māori. The rationale for the approach taken to this work is three-fold, as explained by Paine and Gander (2013). First, health, in the fullest sense of the word, is an inalienable right of all people in Aotearoa/New Zealand. Second, the inequities in health observed in our population are not inevitable, nor are they considered fair, just or irreversible. The factors contributing to the poor health status observed in various social groups, and in particular for Māori, are interwoven and complex and research must include inspection of the broader psychosocial determinants of health, including access to the resources necessary to obtain and maintain optimal health. For this reason socioeconomic status and ethnicity are always included in analytic models. The distribution of age differs between the Māori and non-Māori populations, and on average Māori also have a shorter life expectancy than non-Māori—76.5 years for Māori females compared with 83.7 years for non-Māori females (Statistics New Zealand, 2013b). Age is therefore another requisite variable in analytic models. Third, the research approach has been grounded in an indigenous approach to research termed Kaupapa Māori research, which provides a philosophy that guides the work (Bishop, 1999; Cram, 2001; Smith, 1999). Proceeding with research in this way attempts to contribute to an on-going process of monitoring the Crown in respect of its Treaty obligations.

The E Moe, Māmā project was guided by three key principles from the Kaupapa Māori research approach to sleep epidemiology, as described by Paine and Gander (2013, p. 693)

"First, there must be Māori participation and control at all stages of the research. Second, ethnicity data must be collected appropriately. Third, studies must seek to achieve equal explanatory and analytical power."

These three Kaupapa Māori research principles were embraced in the following ways in the E Moe, Māmā study:

(1) *Māori participation and control at all stages of the research.* To support the principle of participation in the E Moe, Māmā study, two principal investigators co-lead the project, one Māori and one non-Māori. A senior Māori health researcher also sat on an advisory group established to give expert input and support to the entire research team

and project. Māori researchers were responsible for building and maintaining relationships with Māori communities and groups, as well as give leadership to Māori recruitment and retention processes. The Māori co-principal investigator also held the role of kaitiaki (guardian) of Māori participants and their information. A junior Māori health researcher assisted in this role, and community based Māori women acted as local 'champions' of the study, providing face-to-face contact and networking. Recruitment strategies were tailored for Māori and non-Māori recruitment, for instance some posters were just in English and others were in English and te reo Māori (the Māori language).

(2) *Appropriate collection of ethnicity data.* Historically, Māori have been undercounted in health datasets because of a number of mechanisms such as identifying being 'Māori' using biological or ancestry approaches, or in situations where the individual or their family do not have the opportunity to record ethnicity Te Ropu Rangahau Hauora a Eru Pomare (2000). An example of this was the undercounting of Māori babies in the sudden infant death statistics for New Zealand. Parents completed birth certificate documents and had the opportunity to state ethnicity, however, death certificates were completed by health professionals who may make assumptions about ethnicity Te Ropu Rangahau Hauora a Eru Pomare (2000). This finding exposed a similar issue in recording of ethnicity on death certificates (and other morbidity datasets) at all ages. In recent times, how Government defines Māori has changed from an approach based on quantum of blood, to one of self-identified ethnic affiliation (Robson & Reid, 2001). In the present studies, if a woman identified as being Māori as their sole choice, or one of many ethnicity choices, she was classified as Māori and everyone else was classified as non-Māori.

(3) *Achieving equal explanatory and analytical power.* New Zealand health agencies are obligated to reduce the disparities that exist in Māori and non-Māori health (Ministry of Health, 2002c). Addressing these disparities requires investigation of both the size of the difference and explanations for the difference. The epidemiological statistical strategy of 'equal explanatory power' is recommended to facilitate both goals in New Zealand health research (TRRHaEP, 2002). Data is collected for equal numbers of Māori and non-Māori to facilitate the same level of enquiry and analysis for Māori as for non-Māori. The E Moe, Māmā study aimed to recruit 500 Māori and 500 non-Māori women.

I am a first generation New Zealander and my ethnicity is New Zealand European. This thesis is by no means an attempt to undertake or present my efforts from a Kaupapa Māori perspective, which would include analysis and discussion focused on understanding and explaining any differences observed between Māori and non-Maori. The data in the E Moe, Māmā Study was collected according to this kaupapa (set of guiding principles),

which I believe to be respectful of all participants, and a grounded approach for any researcher. Descriptive data will therefore be presented for Māori, non-Māori and the total study sample, and analyses will include ethnicity (Māori vs. non-Māori), maternal age and a measure of socioeconomic position (NZDep2006) as potential explanatory factors (covariates). The focus of the PIPIS Study was to trial an intervention and study processes, conducted with a small group of women who were attending childbirth education classes offered by the same provider group. This was done in order to present the intervention within an existing community education setting and to allow greater control of some demographic variables. Equal numbers of Māori and non-Māori women were not sought. Therefore, Kaupapa Māori principles 1 and 3 were not followed in the PIPIS Study and, this being the case, a Māori/non-Māori analytic framework was not appropriate.

Finally, the scope of this work crosses several disciplines including public health, sleep science, psychology and anthropology. The Publication Manual of the American Psychological Association (American Psychological Association, 2010) was used to guide many aspects of presentation. However, the order or presentation of data in this thesis was also informed by the conventions of the other disciplines listed. The terms 'postnatal' and 'postpartum', 'antenatal' and 'prenatal', and 'perinatal' and 'peripartum' are used interchangeably throughout the text.

Acknowledgements

He aha te mea nui o te ao?
He tangata! He tangata! He tangata!
What is the most important thing in the world?
It is people! It is people! It is people!

No one is more surprised than me that I find myself in the happy position of sharing my deepest gratitude to many people for their assistance in my journey through doctoral travail. When my parents emigrated to New Zealand in the 1950s, in search of a better quality of life for their future family, I don't expect it ever occurred to them to envisage not one, but all three of their children completing postgraduate education. Thank you Mum and Dad for being brave enough to venture to new lands, far from your family and friends, in pursuit of more. I hope this work in some way vindicates your choices. I promise I will get a proper job now. My two brothers, Mark and Sean (and their wives and families), have resolutely offered me their unwavering belief, encouragement and support, over the past 10-years of academic study. How could I not aspire to be like you both? … and now it's time for a beer. *Sláinte!*

It is a tall order to ask a woman who is pregnant or has a brand new baby to participate in research, especially when that research includes home visits, technical equipment and regularly keeping track of activities in a diary. *Thank you* to all of the women and families who participated in this research. Your contributions are already making a difference.

The wider E Moe, Māmā Project represents the collective efforts of many people including our epic project team: Principal Investigators Leigh Signal and Sarah-Jane Paine with Dee Muller, Monique Priston, Philippa Gander, Mark Huthwaite, Kathy Lee, Alexander Smith, Kara Mihaere, Larine Sluggett, Meg Thompson, Perrine Boy and Francesca Kliffen. What a joy and a privilege it has been to work with you all. Thank you everyone.

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There is a saying that "it takes a village to raise a child", and I think it also takes a village to complete any great undertaking. I am blessed that my village is more like a small city, starting with my colleagues at the Sleep/Wake Research Centre. Philippa Gander's knowledge and passion for the field seems to know no bounds and she has created an environment where students are encouraged and thrive and where families really do matter. How lucky I was to have knocked on your door as a 3rd year undergraduate looking for a research project! Sarah-Jane Paine—colleague, friend and guide, blessings SJ. Together with Rosie Gibson, our little Breakfast Club was a sanity saver and you so often had just the right words to say or article to refer to. Rosie! Who could ask for a better PhD office buddy—you'll probably get some work done now I'm gone. Margo van den Berg, Karyn O'Keeffe, Sarah Jay, Alex Smith, Hannah Mulrine, Laura Howe and Kanch Pathirana—you guys have all helped enormously with my learning about sleep, physiology, research, statistics, and life, but more than that, you've laughed with and encouraged me along the way. And to Dee Muller, my own personal "just keep swimming" coach. Thanks for all the treats, coffees, rants, practical help and hugs. You really did make a difference. *Kia ora, te whānau!*

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To my primary supervisor, Leigh Signal, thank you a thousand fold. Leigh is an internationally acclaimed expert in the field of sleep science, an accomplished researcher and a skilled educator. But what sets Leigh apart is her unique capacity for leadership. Believe me, I never set out to start a PhD, or speak at international conferences, but somehow Leigh engendered belief and confidence in me and I never quite knew how it happened. She shares her knowledge generously and knows just how far to push people—then sometimes gets away with nudging (dragging?) them a little further. On top of that she is a fine friend, a fabulous mum and a mean water skier.

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Villages always have people in them who keep life ticking along—the quiet ones, working away in the background, not asking for recognition and not making a fuss. My husband, Simon, is that person for me. We both strive hard in our work and usually this just happens. But sometimes the demands are a bit excessive and out of balance—like the last year or so! You, more than anyone, understand the significance of this achievement, and I share it all with you. It *must* be my turn to cook, and this summer we *will* be watching *a lot* of tennis together.

Finally, it was becoming a mother that set me on this path in the first place. To my daughters, Meg and Bridie, you were beautiful little girls when I started this journey and now you are beautiful young women. You inspire me every day. Remember the poem by e.e. cummings, i carry you in my heart? It describes love so deep that it can keep the stars apart, just like a mother's love… just like your mama's love.

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Table of contents

List of tables

List of figures

List of appendices

List of terms

Actigraphy	A method of assessing rest and activity, using a non-invasive technique, over a period of time–usually several days to several weeks.
Actiwatch	A wrist-watch like device, containing an accelerometer, used to collect actigraphy data.
Antenatal	Before childbirth
BMWS	Brief Measure of Worry Severity
Dream feed	See focal feed.
EEG	Electroencephalogram
E Moe, Māmā	"Go to sleep, mothers"
EPDS	Edinburgh Postnatal Depression Scale
Focal feed	Waking an infant at night (usually before midnight), so as to feed them at a prescribed time, with the goal of minimising infant waking later in the night. Also called a dream feed.
GNS	Good night's sleep
GSDS	General Sleep Disturbance Scale
Hauora Hinengaro	Mental health
Kaitiaki	Guardian
Kaitiakitanga	Guardianship
Kaupapa	A set of values, principles and plans which people have agreed on as a foundation for their actions.
Koha	A gift, contribution, or act of reciprocity.
Manaakitanga	Hospitality
Perinatal	Around childbirth
Perinatal distress	The occurrence of depression, anxiety, worry and/or stress in the perinatal period.
Perinatal period	The period of time surrounding conception, pregnancy, childbirth and the first postpartum year.
Peripartum	Around childbirth
PIPIS	Parent Information on Parent and Infant Sleep
Postnatal	After childbirth
Postpartum	After childbirth
Prenatal	Before childbirth
PSG	Polysomnography
PVT	The psychomotor vigilance task

REM	Rapid eye movement
nREM	Non rapid eye movement
SIDS	Sudden infant death syndrome
SUDI	Sudden unexpected death in infancy
Te Reo Māori	The Māori language
Tikanga Māori	Māori customs and practices
TST	Total sleep time
Wahakura	A woven, flax basket intended for infant sleep up to the age of about 5-6 months. Wahakura provide a safe sleeping space for infants and can be used in or out of the parental bed.
Whānaungatanga	Kinship, relationship

Chapter One

O! That moment of immeasurable ease
which comes on gently rocking boats
in warm contented weather! One floats
as if on Time's eternal seas,
a million years slip by with every
lurch and lulling pitch. A reverie
held in wobbly balance between
a savage sleep (pre-Pleistocene)
and playful, sweet Arcadian reason;
that moment between our circadian seasons,
half-Somnus, half-genius! Asleep and awake.
To live in that balance, what poets we'd make!

Extract from Res Publica, Book One, Canto the First, by Zireaux

Introduction

In the year ended December 2012, 61,178 babies were born in New Zealand, bringing the population total to 4.4 million (Statistics New Zealand, 2013a). During an approximately nine month lead up to birth, a raft of pregnancy related alterations have the potential to impact the sleep and well-being of each infant's mother. Approximately one in five women experience depression after the birth of their infant (Gavin et al., 2005), and one in ten experience depression during pregnancy. A further 10-16% of women are affected by anxiety after birth (Leigh & Milgrom, 2008). Postnatal depression has been described as a crippling mood disorder and a "thief that steals motherhood" (Beck, 1999, p. 41), as mothers struggle to find confidence and pleasure in life or parenting.

The perinatal period includes the experiences surrounding conception, pregnancy, childbirth and the first postpartum year (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2012) and during this time women undergo enormous physiological and psychological change. Almost every aspect of physiology is impacted by the peripartum experience (Frederiksen, 2001; Pien & Schwab, 2004). A woman's psychological self is also affected by pregnancy-related neurological changes (Insel & Young, 2001; Strathearn, Fonagy, Amico, & Montague, 2009) as well as cognitive and emotional preparation for this major life transition (Matthey, Barnett, Ungerer, & Waters, 2000; Petch & Halford, 2008). These physiological, emotional and cognitive changes influence, and are influenced by, the perinatal woman's behaviours, and all of this occurs

within her own, unique environment or context. Sleep occupies approximately one-third of healthy adult life and it is not surprising that sleep is impacted by, and has an impact on, these perinatal changes.

A wide range of biological and psychological factors have been proposed as possible causes of sleep disruption, or possible mediating factors in the relationship between sleep disruption and the health of pregnant women and postpartum mothers. Changes to sleep during the perinatal year are taken as normal and are often minimalized, even though the magnitude of change and/or the consequences of sleep changes can be severe. A better understanding of these relationships is needed to help identify women whose physical and psychological health may be compromised by poor perinatal sleep, and to develop appropriate interventions that could improve the sleep, health and well-being of women and their families through this critical transition period.

Sleep changes in pregnancy and the postpartum period are reported anecdotally by women and their families, and have been observed in empirical research. Poor sleep seems to be a widely regarded inevitable consequence of the reproductive process. It also seems that because this is such a widespread and expected phenomenon, until very recently little emphasis has been placed on the prevalence, magnitude or impact of such changes on the woman and her baby. At the same time, individuals affected by a psychiatric disorder, such as depression, are also likely to experience disturbed sleep, and this disturbed sleep is often regarded as secondary to, and almost an inevitable bed-partner of the primary disorder of focus (Harvey, 2009). The significance of sleep disturbance, therefore, becomes trivialised in both groups. What happens when a pregnant or postpartum woman with poor mood also reports poor sleep?

Anecdotally, pregnant and postpartum women who voice sleep difficulties report responses from their health professionals, family and friends along the lines of *"I tell all my women it's only sleep, it's totally over-rated"*, and *"you're having a baby, what do you expect?"* One possible motivation for such comments is an approach where pregnancy and birth are viewed as normal physiologic events, which women's bodies are designed to cope with, as opposed to medical events in need of constant monitoring and management. A desire often expressed by midwives and others who work with these women is to not pathologise sleep in normal, healthy pregnancy, birth and the postpartum period. How do we know what *is* normal or healthy sleep at this time though?

Pregnant women in New Zealand are required to choose a Lead Maternity Carer to co-ordinate their maternity care, usually from early pregnancy until four to six weeks postpartum (Ministry of Health, 2013b). This person can be a registered midwife, general medical practitioner with a diploma in obstetrics, or an obstetrician. Seventy-nine percent

of women opt for a midwife as their Lead Maternity Carer (Ministry of Health, 2012b) with many midwives working in small, independent practices. Midwives, general medical practitioners, obstetric consultants, and nurses in New Zealand are likely to have received only one or two hours' education about sleep/wake functioning during their basic training. For instance, Massey University nursing students receive 1-2 hours of general sleep education in their third year of studies and Otago University fifth year medical students receive one two-hour lecture and a two-hour lab experience (K. O'Keeffe, Massey University, personal communication, 25 November 2013). Perhaps then, another less obvious reason for unhelpful reactions to perinatal sleep difficulties expressed by mothers is that by not understanding the extent, causes and consequences of sleep change there is a void of knowledge about how to assist women to manage and cope with disrupted sleep at this time. This lack of knowledge and understanding in turn may leave health professionals, family and other supporters of the new mother, disempowered, unable to offer little more than a prosaic response when women raise sleep as a problem.

Despite constituting one third of normal human daily activity, the scholarship and medicine of sleeping and sleep function is a relatively new endeavour, with the greatest developments in the field occurring in the last 60 years (Kirsch, 2011). Prior to the 1950s sleep was viewed as a static neural and cognitive event during which the brain was switched off, or at least was in idle mode (Dement, 1998). This view of sleep as a passive process persists today, and many individuals are raised with a simplistic view of this essential and dynamic process: sleeping too little makes you grumpy; sleeping too often or too long makes you lazy; and not much is taking place in either mind or body during our deepest slumbers. Contemporary researchers are, however, trying to increase the understanding of circadian biology and sleep/wake function—how frequent is too often, how much is too long (or too short) and what occurs in the body during sleep or sleep deprivation? An increasing number of links are being made with potentially negative effects of poor sleep quality and quantity, which range from daytime sleepiness (Bartlett, Marshall, Williams, & Grunstein, 2008) and reduced performance, which may be short or long term depending on the cause (Belenky et al., 2003; Van Dongen, Maislin, Mullington, & Dinges, 2003), to long term increased risk of mortality (Grandner, Hale, Moore, & Patel, 2010). Does it really matter that women have less or more disrupted sleep during pregnancy or in the postpartum period, and when do sleep changes move from being just plain tiresome to risky and of clinical or real-world significance, such as for the mental health and well-being of a new mother?

Sleep disturbance in pregnancy is associated with hormonal changes, physical discomfort, longer sleep onset latencies, body temperature changes and vivid dreams and

nightmares (Balserak & Lee, 2011). Once the infant is born, awakenings associated with feeding and care of the newborn, continue to disrupt sleep. A limited amount of evidence exists to show the occurrence of large changes in sleep quantity and quality across pregnancy and the postpartum period, with very few studies investigating either the changes in sleep, or the consequences of these changes for New Zealand women.

Human sleep

> *"It is remarkable that the function of sleep is still unknown, despite the general acceptance that sleep leads to some form of recuperation."* (Tobler, 2011, p. 112).

All mammals sleep (Siegel, 2005) but, to date, there is no 'grand' unified theory explaining *why.* Much of our understandings of the functions of sleep are drawn from evidence of what happens when sufficient sleep is not obtained, with negative cognitive, psychologic and physiologic sequelae observed. The definition of sleep sufficiency is multi-faceted in itself. Sleep must be of sufficient duration (sleep quantity), it must be sufficiently restorative (sleep quality), and it must occur during a certain time in the 24-hour day/night cycle for normal, healthy functioning to occur.

Broadly defined, human sleep is a quickly reversed state of diminished responsiveness to the internal and external environment, during which the sleeper is largely immobile (Carskadon & Dement, 2011; Siegel, 2005), although diminished, responsiveness to the external environment is not complete, as in coma. Reduced sensory processing still occurs in sleep, as evidenced by the mother who is more likely to respond to the sound of her own infant's cry than that of another infant (Carskadon & Dement, 2011). When sleep need is not sufficiently met, humans, including new mothers, are innately driven to try and recover the lost amount (Siegel, 2005) as demonstrated by significantly shortened time to sleep onset, the intrusion of microsleeps into wakefulness in sleep deprived adults and pronounced deep sleep (slow wave) brain activity and duration early in the first sleep opportunity after deprivation (Goel, Rao, Durmer, & Dinges, 2009; Schechtman, Harper, & Harper, 1994).

In evolutionary terms, sleep has been described as an adaptive behaviour, designed to maximise efficient energy expenditure and protect organisms from risk through predation or injury (Siegel, 2011). Energy and safety demands are high in the early postpartum period as the mother recovers from pregnancy and childbirth, establishes lactation, makes the transition to motherhood, learns parenting skills, and provides care, protection and transportation for her vulnerable newborn.

The literature describing normal sleep and the causes and consequences of abnormal sleep is vast. Through these cumulative research efforts, sleep has emerged as a complex interplay of physiological, psychological, behavioural and environmental factors. To more fully understand the functions of human sleep, much has been inferred from observing the sequelae of impaired sleep, and to understand what constitutes 'impaired' sleep a definition of unimpaired or 'normal' sleep is required.

Normal Sleep

By nature, humans are diurnal creatures who are awake and active during the day and, in general, consolidate their sleep into one or more long periods at night. Current understandings of what drives us to have regular, consolidated night-time sleep are founded on a two-process model. In this model the timing and structure of sleep occur as a consequence of the interaction between a homeostatic process of sleep drive (an increasing urge to sleep) and a circadian (meaning about a day) process that maintains rhythmic timing of numerous brain and body activities, independent of actual sleep occurrence (Borbély & Achermann, 1999; Wirz-Justice, 2006).

Circadian biological clock and homeostatic drive

The rhythm of sleep and wake states is tightly controlled by an endogenous timing system or 'internal biological clock'. Deep within the brain's hypothalamus are the bilaterally paired suprachiasmatic nuclei (SCN). The SCN unit is considered to be the master controller of bio-behavioural rhythms in mammals (Turek, 2011).

Circadian mechanisms which influence metabolic and neurologic activity at a local level are also found throughout the body but they remain synchronised by the SCN. Evidence of the rhythms of such processes can be inferred by the daily rise and falls in body temperature, and similar changes in plasma and salivary levels of markers such as growth hormones, melatonin, cortisol and insulin (Hastings, Maywood, & Reddy, 2008). Through these endogenous controls and biochemical activities, and through our alignment to the 24-hour day by exogenous cues (most especially daylight, but including other socially-mediated events such as meal times, work times and clock use) we are set up to sleep and wake in a cyclical way (Herman, 2005). The peak time of sleep need is approximately 2 a.m. to 5 a.m., with a lesser peak also occurring mid-afternoon (Carskadon & Dement, 2011). Not coincidentally, the peak times for road traffic accidents are 2 a.m. to 6 a.m., and 1 p.m. to 4 p.m. (Garbarino, Nobili, Beelke, De Carli Phy, & Ferrillo, 2001; MacLean, Davies, & Thiele, 2003).

The second process of homeostatic drive is a process whereby the desire or propensity for sleep rises in parallel with continued waking, and dissipates during sleep

(Borbély & Achermann, 1999). The longer a person is awake, the greater the drive or pressure becomes for them to obtain sleep. Two troughs in propensity for sleep have also been identified. These so called 'wake maintenance' or 'forbidden sleep' zones occur in the late morning and early to mid-evening (Lavie, 2001). During these times, even if behaviourally motivated to take a nap or longer period of sleep, physiologic processes regulated by the SCN may prevent or delay sleep onset.

The circadian biological clock and homeostatic drive process are thought to operate in a largely independent but 'intimate' relationship, although they do not necessarily run according to the same timing. The strongest timing cue for the circadian biological clock is light (Peirano & Algarín, 2007), and the process of constantly synchronising it to the external solar and social environment is known as 'entrainment' (Hastings, O'Neill, & Maywood, 2007). To feel refreshed and restored, sleep needs to be of sufficient duration to meet individual needs, occur in long, consolidated episodes (with minimal interruptions) and take place during night, when human physiology is hardwired to activate sleep-congruent processes, such as the release of growth hormone.

During an individual's circadian night normal changes in physiology (including the peaks and troughs of production or release of various hormones and neurotransmitters) contribute to restorative sleep. Our internal circadian night can be displaced from the external environmental night, for instance when individuals participate in shift-work, when we travel across time zones and experience jetlag, or for those whose circadian night, and therefore preferred sleep/wake timing or 'chronotype' (Roenneberg et al., 2007) occurs at times which are not aligned to most of society's daily activities. The naturally occurring circadian phase of sleep in so-called extreme 'larks' is advanced so that they wake early in the morning, such as between 4 a.m. to 5 a.m. and fall asleep in the early evening. In contrast, the naturally occurring sleep phase of extreme 'night-owls' is delayed, so that these individuals tend towards usual bedtimes well past midnight and rise times around the middle of the day or early afternoon. Extreme larks and owls can function well so long as they are not required to align their work and social schedules with common daytime work or school schedules (Wittmann, Dinnich, Merrow, & Roenneberg, 2006), although the long term effects of this temporal misalignment are still under investigation (Hastings et al., 2007).

Sleep architecture

Like waking, sleep is an active and dynamic process during which characteristic activities and cyclical patterns have been observed (Carskadon & Dement, 2011). Normal human sleep comprises two well defined states—non-rapid eye movement sleep (NREM)

and rapid eye movement sleep (REM). Associated with each state are particular electroencephalographic (EEG) wave forms, somatic movements, muscle tone changes and respiratory patterns which can be objectively measured using polysomnography (see Measuring Sleep, page 15). The patterns, timing and absolute and percentage contributions of the various stages and transitions during sleep are collectively referred to as 'sleep architecture' (Redline et al., 2004).

Except for in early infancy, sleep is entered through NREM, which is commonly classified into three stages in healthy adults, N1, N2 and N3, with each stage indicating a deeper level of sleep state (Silber et al., 2007). As sleep deepens, the threshold for arousal as a result of endogenous or exogenous stimuli becomes higher. At the commencement of a normal night's sleep, N1 sleep usually lasts just a few minutes before transition into N2 which lasts between 10–25 minutes. N3 sleep lasts around 20–40 minutes in the first cycle of night sleep. The deepest stage of sleep, N3, is also referred to as 'slow wave' sleep (Novelli, Ferri, & Bruni, 2010).

After a time in NREM sleep, an increase in body movements may be seen as the sleeper ascends from N3 through N2 and N1 into a period of REM sleep. The first period of REM sleep at night is very short (1–5 minutes), but subsequent periods become longer across the night. At the same time, less time is spent in deep sleep as the night progresses. During REM sleep EEG activity is similar to that seen during wakefulness and dreaming occurs mostly in this stage. REM sleep occupies about 20–25% of adult sleep duration, with 75–80% of sleep spent in NREM sleep. A full night's sleep consists of multiple cycles of REM and NREM, with each full cycle taking, on average, 90–110 minutes to complete.

During waking, the brain is in a heightened state of activity. Neuronal networks throughout the brain communicate in a rapid, asynchronous fashion in response to the constant stream of information being received from the internal and external environments. Evidence of this activity can be observed through analysis of the oscillations in electrical potentials in the brain's cortex, recorded in EEG monitoring. EEG waves during waking are typically high in frequency and low in amplitude (beta waves in the 14–30 Hz frequency range). Alpha waves (in the 8–12 Hz range) are dominant during quiet, eyes-closed, relaxed waking. As sleep onset occurs, cortical firing becomes more synchronous and EEG waves increase in amplitude. In stage N1, the sleeper begins to lose conscious connection with the external environment and theta waves in the 4–7 Hz range become predominant. Loss of connection with the external environment is complete in N2, and specific characteristic waveforms appear as the hallmarks of this stage ('sleep spindles' and 'K-complexes'). As the sleeper moves into deep sleep (N3), large groups of cortical neurons fire in synchrony resulting in EEG waves of high amplitude and slow

frequency. They are known as delta waves and are in the 1–3 Hz range (Fuller, Gooley, & Saper, 2006). The percentage of time spent in slow wave sleep appears to decline significantly from pre-pregnancy to the first trimester, with no improvement seen until the postpartum (Lee, Zaffke, & McEnany, 2000).

During REM sleep, EEG waves return to the beta range (high frequency) and, on observation, resemble waking activity. The time taken to reach the first episode of REM during a sleep period, the amount of REM activity in a sleep period and duration in REM, are all altered in depression. Objective studies of sleep structure during pregnancy have produced mixed findings. It appears that when compared to non-pregnant women, the percentage of REM sleep experienced by pregnant women is very similar or may reduce slightly across pregnancy (Balserak & Lee, 2011).

Sleep is not continuous as this text-book style description may imply. Fragmentation is the term used to describe any interruptions to sleep continuity and some degree of fragmentation is a feature of normal sleep. Sleep can become fragmented via a number of mechanisms. These include gross physical disturbance such as being shaken awake by another individual, physiologic responses to other subtle endogenous and exogenous stimuli, such as changes in blood pressure or environmental noises, and as a result of expected transitions between sleep stages (Kato, Montplaisir, & Lavigne, 2004).

Fragmentation can be observed as changes in cortical EEG activity, and defined as arousals or shifts to N1 sleep or wake from any of the other sleep stages (Paruthi & Chervin, 2011). An arousal is an abrupt shift in EEG frequency towards waking EEG, with characteristics including frequencies higher than 16 Hz, without spindles, and with or without theta and alpha activity (Bonnet et al., 2007). The difference between a cortical arousal and an awakening is a somewhat arbitrary and flexible notion, however, in 1992 the American Sleep Disorders Association published criteria by which EEG events in sleep can be defined, scored and classified for clinical and research purposes (Bonnet et al., 1992). Briefly, the definition requires an abrupt shift in EEG frequency towards awakening, which must have been preceded by at least 10 continuous seconds of sleep, and which lasts for at least 3 seconds. Depending on the stage of sleep during which the arousal is observed, further criteria may need to be met, such as changes in muscle tone. Arousals lasting between 3–10 seconds are sometimes referred to as micro-arousals, while arousals lasting longer than 15 seconds may be referred to as awakenings (Kato et al., 2004), although the sleeper may not have any conscious memory of having been fully awakened. All arousals elicit physiological consequences including changes in breathing, heart rate and blood pressure.

Sleep quantity

Ample scientific evidence has now accumulated to support the conclusion that sleep is an essential basic human need that, like our needs for food, water and air, must be satisfied in order to for us to survive (Banks & Dinges, 2007). How much sleep each of us needs on a daily basis in order to be healthy, happy and safe, varies between individuals. A pragmatic response to the often-asked question of how much is enough sleep is: whatever it takes for an individual to awaken and feel alert and refreshed, and to restore normal function (Gander, 2003).

Sleep research has continued for over 60 years in a quest to increase precision and understanding of how much sleep humans need on a daily basis. It is widely hypothesised that healthy adult humans need 7–8 hours of sleep per night (Banks & Dinges, 2007). In 1982 more than 1.1 million adults, aged 30–102 years, participated in the Cancer Prevention Study II of the American Cancer Society (Kripke, Garfinkel, Wingard, Klauber, & Marler, 2002). Seventy-one percent of women in the study reported sleeping between 7–8 hours per night, while 20% reported shorter sleep durations and 9% reported sleep durations greater than 8 hours per night. The authors found an elevated risk for mortality for participants who reported sleeping less than 6.5 hours or more than 7.4 hours per night.

In 2007, National Sleep Foundation, America, conducted a national telephone survey using a random sample of 1,003 women (National Sleep Foundation, 2007). The Sleep in America poll made the distinction between work and non-work days and women reported their usual time in bed. On average, women who were surveyed reported their usual time in bed on work days to be 7.5 hours, and on non-work days average time in bed was 8.5 hours.

Seven to eight hours of sleep a night are considered vital to optimal neurocognitive and behavioural performance (Banks & Dinges, 2007; Carskadon & Dement, 2005; Dinges, Rogers, & Baynard, 2005). Reductions in sleep quantity and quality lead to increased sleepiness which in turn has been shown to lead to such changes as: response slowing, attention lapses, slower information processing and microsleeps (the intrusion of sleep preparation and onset behaviours into waking), as well as an increase in poor risk-taking decisions (Banks & Dinges, 2007; Belenky et al., 2003; Roehrs, Carskadon, Dement, & Roth, 2005). The effects of sleep loss are cumulative, in a dose-dependent way, and more than two nights of unrestricted sleep are needed to return cognitive performance to pre-experimental baselines (Belenky et al., 2003; Dinges et al., 1997; Lamond et al., 2007). Vulnerability to impairment from sleep loss varies between individuals in a trait-like manner (Van Dongen, Baynard, Maislin, & Dinges, 2004). This, combined with the

cumulative effects seen in performance degradation after sleep loss, means that even small changes in sleep quantity and quality can produce marked neurobehavioural performance deficits in vulnerable individuals.

Sleep quality

> *"Although sleep quality is a readily accepted clinical construct, it represents a complex phenomenon that is difficult to define and measure objectively."* (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989, p. 194).

The construct of 'sleep quality' is widely referred to in sleep medicine and research, yet, an accepted and rigorously formulated definition is elusive. Definitions of sleep quality vary, with sleep duration often examined as an integral part of sleep quality. Other definitions focus on quantifying fragmentation of the normal stages of sleep and/or self-reports of perceived sleep quality, such as difficulty with falling asleep, staying asleep or feeling refreshed after sleep.

In a review of measures of sleep quality, Krystal and Edinger (2008) reported the following commonly used measures as reflecting individuals' subjective ratings of sleep quality: total sleep time (total sleep duration during a defined period), sleep onset latency (time taken to fall asleep), sleep fragmentation (any disturbance to the continuity of a sleep period), awake time (including mid-sleep awakenings and early awakening), sleep efficiency (the ratio of time spent in bed trying to sleep to actual total sleep time), and number and type of events that disturb sleep such as spontaneous, brief awakenings or arousals and sleep related apnoeas.

Single item, Likert-style ratings are commonly used to assess subjective sleep quality, such as "How often can you say *I had a good night's sleep*" (National Sleep Foundation, 2007). Using this question, the previously mentioned National Sleep Foundation poll of women's sleep found that 39% of women reported getting a good night's sleep every night or almost every night, whilst 29% reported getting a good night's sleep on only a few nights every month. Paine et al. (2005) reported the prevalence of insomnia in a random sample of Māori (n = 565) and non-Māori (n = 881) women from the New Zealand general population, aged between 20–59 years. When asked how often they felt refreshed upon awaking 62.7% of Māori and 55% of non-Māori reported never or rarely waking refreshed. Mid-sleep awakenings greater than three times per night were reported by 29.2% of Māori and 21.3% of non-Māori, while 39.8% of Māori and 29.1% of non-Māori reported difficulty falling asleep (Paine, Gander, Harris, & Reid, 2004).

Comprehensive instruments have also been developed specifically to measure subjective sleep quality, such as the Pittsburgh Sleep Quality Index (Buysse et al., 1989) and the General Sleep Disturbance Scale (Lee, 1992). Both of these instruments have been used to investigate sleep disturbance in the perinatal period (Goyal, Gay, & Lee, 2007; Okun, Hanusa, Hall, & Wisner, 2009; Stremler et al., 2006).

Sleep quality may be defined objectively through physiologic recordings of sleep onset latency, total sleep time, wake time after sleep onset, sleep efficiency (time spent in bed compared to time actually in sleep), number of awakenings (which are often corroborated by questionnaire or sleep diary) and frequency and number of spontaneous arousals recorded by EEG. While these measures provide empirical evidence of sleep related events, such as timing, duration and frequency of sleep periods or disturbances to sleep, they remain insufficient to capture variations in the lived experience of sleep itself (Krystal & Edinger, 2008). For instance, normal sleepers and insomnia sufferers are not always differentiated using measures like this alone—these measures may not yet be sensitive enough to capture aspects of sleep which cause one individual to report feeling refreshed and another not, even after objectively identical sleep experiences.

In the sleep/wake context, 'fully alert' and 'sleep' form the anchor points on a hypothetical continuum of the state of vigilance. Around the clock continuity of brain function is required to sustain life—the brain never ceases to be active, it just has altered patterns of activity during sleep. Vigilance relates to the amount of conscious perception an individual has of events and their surroundings (Halaszi, Terzano, Parrino, & Bodizs, 2004), and it has been defined as "the ability of organisms to maintain their focus of attention and to remain alert to stimuli over prolonged periods of time" (Warm, Parasuraman, & Matthews, 2008, p. 433).

Sleep quality is directly impacted by fragmentation. The source, timing, duration and frequency of arousals during sleep can all combine to contribute to how refreshed and satisfied with their sleep an individual feels, or not.

Disturbance to normal adult sleep

As previously described, sleep disturbance can be attributed not only to attenuation in sleep quantity but also to a reduction in sleep quality. Disruptions to sleep which cause the integrity of the sleep cycle to become fragmented can occur even when total sleep time is preserved (Insana, Williams, & Montgomery-Downs, 2013). What, then, leads to insufficient sleep quantity and quality?

Normal, healthy sleep can be disturbed in a number of ways. Work schedules, social demands, environmental disruption, physiological and psychological disruption (including

pain) and domestic responsibilities, such as caring for infants at night, can all disturb and therefore restrict the amount of sleep obtained by an individual. Total loss of sleep in a 24-hour period (or longer) is referred to as 'acute' sleep deprivation and studies have consistently found that acute sleep deprivation produces significant changes in mood, alertness and cognitive and psychomotor performance (see Bonnet, 2011, for a review).

Frequent acute sleep deprivation is not the norm for parents; however, it is plausible that on occasion new parents may go a whole night without sleep if caring for an unsettled, fractious or unwell infant. In addition, spontaneous onset of labour follows a circadian pattern, with peak onset occurring around midnight (Kaiser & Halberg, 1962) possibly due to the circadian rhythms in the hormones oxytocin and melatonin (Sharkey, Puttaramu, Word, & Olcese, 2009). A number of women therefore begin a period of intensive caregiving to their newborn after an episode of acute sleep deprivation associated with the birth.

'Chronic' or 'partial' sleep deprivation occurs when an individual does not meet their individual requirement for sleep over a period of days and nights (Banks & Dinges, 2011). Chronic sleep deprivation is both a common occurrence and a cumulative process. 'Sleep debt' has been coined as the term to describe cumulative hours of sleep loss in relation to an individual's specific daily need for sleep (Van Dongen, Rogers, & Dinges, 2003). Many adolescents and adults obtain insufficient sleep over the course of a school/work week, leading to sleep debt, which they may then try and recover from through catch up sleep on non-work/school nights. Given the interruptions to sleep, and the shortened opportunity for night sleep, most, if not all new mothers are likely to be affected by chronic sleep deprivation. For many, this debt begins to accrue during pregnancy, when sleep may be impacted by pregnancy-related disturbance such as nausea, discomfort and frequent nocturnal micturition (Mindell & Jacobson, 2000). To exacerbate this situation, the sleep debt accumulated by mothers is difficult to extinguish when around-the-clock parenting allows for no such respite as a non-scheduled work day or weekend on which to catch up sleep.

Consequences of disturbed sleep

Neurobehavioural consequences

Short-term consequences of sleep loss include increased daytime sleepiness and the intrusion of sleep into waking, as the homeostatic drive for sleep becomes so great as to be irresistible. The measurement of daytime sleepiness is a common method of quantifying the effects of insufficient sleep on daily functioning (Durmer & Dinges, 2005).

Excessive daytime sleepiness describes a state of decreasing vigilance, from full alertness towards sleep. Sleepiness is represented by several mechanisms including: physiologic change in the drive to sleep (a struggle for the brain's alerting systems to hold sleep at bay); behavioural change such as the inability to remain awake and maintain psychomotor or cognitive performance; and change in a person's introspective assessment of their state of alertness (Hirshkowitz, Sarwar, & Sharafkhaneh, 2011). Excessive sleepiness can be a dangerous state, such as when driving and in other safety critical situations. Excessive sleepiness is also associated with poor physical health, such as sleep disordered breathing. While common in pregnancy, excessive sleepiness may not always be normal and it has been associated with adverse pregnancy outcomes including gestational diabetes (Bourjeily, Raker, Chalhoub, & Miller, 2012; Bourjeily et al., 2013).

Cognitive performance has repeatedly been found to become impaired in sleep restriction studies, with the extent of impairment accumulating in a dose-response fashion (Banks, Van Dongen, Maislin, & Dinges, 2010; Belenky et al., 2003; Van Dongen, Maislin, et al., 2003). When comparing total sleep loss with chronic sleep restriction Belenky et al. (2003) argued that recovery of function occurs rapidly after acute sleep loss. Findings of their study suggested that chronic sleep restriction leads to a reduction in performance, which then stabilises, possibly as an adaptive response. The authors suggest that the cost of this response, however, is that a return to baseline function takes much longer than one or two nights of good sleep.

In another study, healthy adults who had sleep opportunity restricted to either 6 hours or 4 hours per night for 14 consecutive nights showed significant neurobehavioural degradation compared to subjects whose sleep opportunity was held at 8 hours per night for the same period (Van Dongen, Maislin, et al., 2003). Alertness, working memory and cognitive throughput were all measured and performance declined in all three tasks (psychomotor vigilance, digit symbol substitution and serial addition/subtraction tasks). The degree of impairment reached the same level as is seen after one to two nights of acute (total) sleep deprivation, depending on the task. Moreover, while cognitive performance showed no evidence of adapting to cumulative sleep loss, and continued to deteriorate across the study period, subjective ratings of sleepiness more-or-less stabilised after two days so that participants reported feeling only slightly sleepy at the end of 14 days of 6 hour or 4 hour sleep restriction. The authors observed that as long as people get at least 4 hours sleep per day they do not have a subjective experience of sleepiness at the same levels as those experiencing total sleep deprivation. These changes improve once there is extended opportunity for sleep but impairment continues to persist, albeit at a lesser level, for at least several days after the restriction period (Belenky et al.,

2003). By running the study for 14 consecutive days and nights the authors gained strong evidence for their hypothesis that humans *do not* adapt to chronic sleep reduction – a contrast to Belenky's findings published at the same time (Belenky et al., 2003). For the present then, the amount of time required for complete recovery from sleep deprivation remains unknown and under debate.

Similarly, in a review of the effects of chronic sleep restriction, Banks et al. (2007) concluded that people underestimate the cognitive impact of sleep restriction and overestimate their readiness to perform cognitive and behavioural tasks, including driving a motor vehicle. Driving is often highlighted as a task at risk of performance deterioration with reduced sleep, partly because of its real world relevance, and partly because, as a task, it reflects numerous components affected negatively by sleep loss, whether on the road or in a simulator (Bonnet, 2005).

Van Dongen et al. (2003) also found that the average amount of sleep needed to prevent cumulative neurobehavioural deficits was 8.16 hours per day, with prolonged wakefulness—as opposed to sleepiness—being hypothesised as the cause for the neurobehavioural deficits. They predicted that wakefulness beyond 15.84 hours (±0.73) produces such effects. Finally, these authors found the performance of some individuals to be more adversely affected by sleep loss than others. Some people appear able to maintain adequate function with 5–6 hours sleep per night, where others may need 10–11 hours. This finding of a trait-like vulnerability to sleep loss has been supported in subsequent studies (Tucker, Dinges, & Van Dongen, 2007; Van Dongen et al., 2004).

To put these consequences into a more ecologically relevant context, a number of studies have compared the reductions in cognitive performance from sleep disturbance to those associated with alcohol consumption. Neurobehavioural performance is tested using a driving simulator, or batteries of tests measuring cognitive processing, accuracy, concentration, motor speed and coordination, in groups who have either ingested alcohol or been sleep deprived. These studies have found that, after one night of sleep deprivation, performance decreases so as to be akin to a level of impairment induced by a blood alcohol concentration (BAC) between 0.08% to 0.10% (Dawson & Reid, 1997; Lamond & Dawson, 1999; Williamson & Feyer, 2000). The legal BAC limit permissible to drive a motor vehicle in New Zealand, the United Kingdom and the United States of America is 0.08%. Further, while performance remains reasonably poor but stable under the influence of alcohol, in sleep deprived groups, performance continues to decline across the duration of the study (Hack, Choi, Vijayapalan, Davies, & Stradling, 2001).

Physiologic consequences

Insufficient sleep, as defined by measures of sleep quantity and quality (particularly difficulty initiating or maintaining sleep) has been associated with mortality from all causes in population studies (Cappuccio, D'Elia, Strazzullo, & Miller, 2010; Grandner et al., 2010). Both short sleep (less than 6 hours per night) and long sleep (greater than 9 hours per night) appear to be associated with immune, endocrine and metabolic change (Cappuccio et al., 2010; Spiegel, Leproult, & Van Cauter, 1999; Spiegel, Tasali, Leproult, & Van Cauter, 2009). In particular, insufficient sleep is seen as a stressor which activates a generalised inflammatory response in the body. Such inflammatory responses are common across a range of disorders including diabetes and cardio-vascular disease. Inflammation is also a common mechanism in a number of neuropsychiatric disorders including minor and major depression (Miller, Maletic, & Raison, 2009) . Inflammation involves the production and release of a range of biomarkers or chemical mediators which influence site specific physiologic responses (as would happen at the site of an injury or trauma) and more general responses in the brain. These neural responses trigger changes in neuroendocrine and neuro-transmitter function, which can alter mood, as well as behavioural changes like social withdrawal and increased sleepiness in the individual. If the stress response is sustained, changes in the structure of the brain can also be observed (Dantzer, O'Connor, Freund, Johnson & Kelley, 2008; Miller et al., 2009).

Not only, then, do people seem to require at least 7 to 8 hours of sleep per night, but predictable negative changes can be measured when sleep quantity falls below these levels, even after relatively short periods of time. These decreases accumulate in a dose-dependent way over time, and will be maintained until such time as there is an opportunity for recovery sleep. Whilst it is feasible that some women will experience periods of total sleep deprivation, either around labour and birth, or in the early postpartum period when dealing with an unsettled newborn, partial deprivation is more likely to be an issue. Further, this deprivation is likely to be chronic (lasting many nights) rather than one-off or episodic. It also appears that consideration should not just be given to an optimal amount of total sleep required, but of equal relevance is individual vulnerability to all types of sleep disturbance and the consequent degree of neurobehavioural performance deficit experienced.

Measuring sleep

The practice of watching over others who sleep is probably as old as time, as tribe members kept watch over their clan by fire, and parents watched (and still watch) their infants at sleep—sometimes in amazement and sometimes in relief. Bringing this practice

into the arena of scientific inquiry began in the 1920s with the seminal work of Nathaniel Kleitman (Dement, 2011), who later assigned graduate students with the very task of watching infants sleeping in order to observe sleep-related motility (Kleitman & Engelmann, 1953). From those early days, the range of methods used to formally observe and classify sleep has grown. As well as direct observation, methods now include polysomnography, videosomnography, actigraphy, sleep diary and self-report questionnaire—each with their own benefits and limitations.

Polysomnography

Polysomnography (PSG) is considered the gold standard for diagnosis, and as a reference standard, when evaluating sleep or sleep measurement methods in clinical and research practice (Stone & Ancoli-Israel, 2011). At a minimum, PSG measurement of sleep/wake states utilises electrophysiologic technology to measure brain waves (electroencephalographic), eye movements (electrooculographic), and muscle (electromyographic) activity (Keenan & Hirshkowitz, 2011). Depending on the purpose of the study, PSG can also record respiratory, cardiac and limb movement activity. PSG studies require specialised equipment and technically competent personnel to set-up equipment, and manage data. Standardised interpretation of data also requires skilled personnel, and is time intensive and costly (Signal, Gale, & Gander, 2005).

PSG studies are often conducted in the laboratory setting to allow standardisation of procedures and for safety reasons, especially when used with children, (Sadeh, 2011b). However, this has the consequence of placing people in a novel environment. Commonly a 'first-night' effect may occur, resulting in deterioration of habitual sleep (Toussaint, 1995). Although it is usual for a first-night effect to occur, this is not always the case. Sleep deprived pregnant or postpartum women were found to enjoy the opportunity for uninterrupted sleep in the hotel-like environment of a sleep laboratory with consequent improvements in habitual sleep (Lee, 1998). PSG is a highly reliable method of data collection, providing rich and detailed information about brain activity, sleep architecture, continuity of sleep and sleep stages. Limitations of PSG include that the technology itself is intrusive, and PSG studies are resource intensive and subject to issues of how well findings can be generalised to settings outside of the laboratory, as well as threats to the ecological validity of data collected in an unusual setting.

Videosomnography

Videosomnography and direct behavioural observation have both been used successfully in studies of adult, infant, and child sleep, and have the advantage of being able to occur in the laboratory or an individual's natural environment (Anders & Sostek,

1976; Baddock, Galland, Bolton, Williams, & Taylor, 2006; Gaylor, Burnham, Goodlin-Jones, & Anders, 2005; Parmelee et al., 1968). They also have the advantage of being able to capture interactions between bed partners or parents and children, which may be of relevance to understanding sleep patterns, behaviours and disorders. Both methods allow for observation of sleep patterns (including quiet and active sleep phases) and awakenings (Sadeh, 2011b). These methods are also resource intensive and can be intrusive, especially if the goal is to collect data for more than one sleep period.

Actigraphy

Activity-based sleep/wake monitoring or actigraphy uses a portable device (akin to a wrist watch in size and shape) and is an extensively used, cost-effective, non-invasive method of objectively assessing sleep in the home, clinical or laboratory environment (Morgenthaler et al., 2007; Sadeh, 2011a; So, Adamson, & Horne, 2007). Actigraphy allows for long periods of continuous assessment and has been validated for use in a wide range of populations including preterm infants and infants under six months of age (So, Buckley, Adamson, & Horne, 2005; Sung, Adamson, & Horne, 2009); children and adolescents (Acebo et al., 1999); adults and the elderly (Ancoli-Israel et al., 2003). The instrument itself solely measures movement of the body part to which it is attached, from which sleep/wake patterns are inferred by specialised computer algorithms. Other sleep parameters, such as sleep stage, cannot be determined by this method. Ease of use and portability mean that use of actigraphy is wide and growing. The 2007 American Academy of Sleep Medicine concludes that actigraphy is indicated for "determining sleep patterns in normal, healthy adult populations" and for "delineating sleep patterns" in infants and children (Morgenthaler et al., 2007, pp 521, 525). Actigraphy has previously been used to quantify normal peripartum sleep duration and quality (Signal et al., 2007), postpartum sleep after caesarean or vaginal birth (Lee & Lee, 2007), and the sleep of mother-infant pairs who completed a postnatal behavioural-education sleep intervention programme (Stremler et al., 2006).

Validation studies have reported reliability coefficients ranging from 0.89–0.98 for normal adult sleep (Stone & Ancoli-Israel, 2011). Most infant validation studies have been conducted with infants six months of age or over, although recently So et al. (2005) reported on the validity of actigraphy when compared with PSG in infants under six months of age. They reported agreement rates of 93.7% in the youngest infants. A predictive value of sleep refers to the percentage of epochs that are scored by actigraphy as sleep that are identified as sleep using PSG criteria (Ancoli-Israel et al., 2003). In the So et al., study the predictive value of sleep ranged from 96.5–98.9%. This is different to

sensitivity for sleep, which refers to the percentage of PSG measured sleep epochs also predicted by actigraphy (So et al., 2005) and this ranged from 67.7–96.2%. The authors also calculated a predictive value for wakefulness as the proportion of actigraphically measured wake epochs that are also classified by PSG as wakefulness (Ancoli-Israel et al., 2003). In this infant study it was concluded that actigraphy is not reliable for predicting wakefulness with predictive values of 17–43.6%. Limitations to this study include that it was conducted in a laboratory setting and that all epochs of sleep containing evidence of artefact from external motion were removed before analysis. This is particularly important in the current context, as a significant challenge of using actigraphy in infant populations comes from artefact introduced into the recording when infants are exposed to external motion, for instance when travelling in a stroller or car, being 'worn' on an adult in a sling, or when being rocked and comforted. This motion is included in activity counts by the actigraph with up to 40% (standard deviation 11%) of recording time affected by such artefact in newborns and young infants (Tsai, Burr, & Thomas, 2009). It is recommended that subjective data (from sleep diaries or questionnaires) be used as an adjunct to actigraphy (Kushida et al., 2001).

Sleep diary

Sleep diaries or logs are one of the most cost-effective methods of collecting sleep data and they have been used across a range of populations from healthy maternal/infant groups (Mindell, Telofski, Wiegand, & Kurtz, 2009; Stremler et al., 2006) to older adults with dementia and their carers (Rowe, McCrae, Campbell, Benito, & Cheng, 2008). Diaries provide information about the pattern and timing of sleep and other contextual information such as sleep location, infant feeding patterns and bed sharing (Thomas & Burr, 2009). Detailed sleep diaries are also considered critical to corroborate actigraphy data and to allow the researcher to consider periods of quiet wakefulness (such as watching television) which actigraphy may determine to be sleep, as well as periods of sleep which include activity from external motion (Sadeh & Acebo, 2002). It has been suggested that combining actigraphy with sleep diary reporting improves motivation for parents to maintain accurate diary records for their children. However, the burden of diary keeping for extended periods of time can reduce motivation and therefore accuracy from the beginning to the end of a monitoring period (Sadeh, 1996).

Self-report questionnaire

Self-report sleep surveys or questionnaires are a widely used, economic and effective method for capturing data in large samples of a population. They also allow investigation of a number of other sleep-related factors, including biological,

psychological, social factors, to be explored in the same set of analyses. No validated questionnaire based measures of sleep or sleep disorders in pregnant/postpartum women are currently available. Multi-dimensional questionnaires have been developed to address specific issues in this population often incorporating well validated measures such as the Epworth Sleepiness Scale (Johns, 1991) or the Pittsburgh Sleep Quality Index (Buysse et al., 1989). The major limitation of self-report questionnaires is the potential for recall bias when asking participants to retrospectively report on their sleep patterns and habits. Data is also less precise, when compared to objective measures such as PSG, and because each new research initiative tends to devise their own custom-designed questionnaire, comparison across studies is limited (Sadeh, 2011b). Despite these limitations, self-report questionnaires offer the most utility in allowing the investigation of sleep in a wide range of populations and in large numbers. The advent of the internet has also enhanced data collection, for instance, a trial of an online version of the Brief Infant Screening Questionnaire (BISQ; Sadeh, 2004) found this version to be a reliable and ecologically valid clinical and research tool, when compared to sleep diary and actigraphy.

Sleep and culture

Until as recently as 150 years ago, human sleep/wake behaviours had evolved in response to the natural environment. Sleep was largely confined to the hours of darkness and waking activities mostly occurred in daylight. Humans are biologically predisposed for long, continuous periods of sleep at night, and long, continuous periods of waking during the day. However, a modern, Western, pre-occupation with getting a good night's sleep, during some pre-determined hours of night may, for the most part, be a socially constructed phenomena. This focus on one period of sleep has been associated with the electrification of homes and factories, starting in the 1850s and reinforced by present day employment schedules. Prior to this time, it is thought that an individual's sleep/wake patterns were much more in sync with the natural environment and seamless in nature, as sleep occurred in line with need rather than clocks (Ekirch, 2001; Worthman & Melby, 2002).

It is interesting to make the distinction between sleep norms in industrialised societies, and sleep norms in other settings, which are far less researched or understood. Worthman and Melby (2002, p. 70) make this distinction in their anthropological survey of the ecology of human sleep:

"Specifically, patterns of solitary sleep on heavily cushioned substrates, consolidated in a single daily time block, and housed in roofed and solidly walled space,

contrast with the variety of sleep conditions among traditional societies. These conditions include multiple and multi-age sleeping partners; frequent proximity of animals; embeddedness of sleep in ongoing social interaction; fluid bedtimes and wake times; use of nighttime for ritual, sociality, and information exchange; and relatively exposed sleeping locations that require fire maintenance and sustained vigilance."

Across all cultures, humans sleep in a recumbent position, but what they sleep on, under or between varies widely according to resources, technological availability, climate, and the need to avoid articles which may harbour allergens (such as dust mites), or parasites (such as fleas or bedbugs); (Worthman & Melby, 2002).

Sleep is seldom solitary in traditional societies, and only recently became so in industrialised societies from the late nineteenth century (Stearns, Rowland, & Giarnella, 1996). A move toward a social milieu valuing autonomy and independence, as well as increasing night recreational and social opportunities for adults brought about by electric lighting, inspired the shift to separate rooms for children, who, resources permitting, were moved to sleep alone in individual beds.

These changes have influenced the structure of family life and expectations about what constitutes 'normal' sleep. Sleep that does not fit these confines may be viewed as a problem. Historical descriptions of preindustrial sleep patterns and observations of present-day tribal societies lend support to the notion that the expectation of consolidated night sleep or "sleeping through the night" early in infancy is quite possibly an artefact of civilisation, electric lighting, and cultural location (Jenni & O'Connor, 2005; Owens, 2004; Tobler, 1995; Wehr et al., 1993). Mothers can feel a moral pressure as a 'good' parent to have their baby sleep through the night, preferably alone, and the infant who achieves this early may be referred to as a 'good baby' (McKenna & McDade, 2005). Early return to paid work (either by choice or necessity) may also put pressure on women to have their infant 'sleeping through the night' at a time when there is potential for a mismatch between the goodness of fit between the infant's physiological maturation and the mother's motivations. Even if a return to work is not imminent, many new mothers are surprised at the level of sleep disruption and fatigue they experience and the desire to obtain sleep can become somewhat of an obsession (Kennedy, Gardiner, Gay, & Lee, 2007).

Little evidence-based information is available, either in the prenatal or early postnatal period, to increase parents' knowledge of what might be realistic expectations for their own and their infant's sleep in the first six to twelve weeks. Advice from friends and family (including the infant's grandparents) may be flavoured by outdated guidance. The Royal New Zealand Plunket Society (Plunket Society) is the main provider of

community infant and child development services in New Zealand. The Society was established in 1907, by doctor Sir Frederic Truby King with an initial goal of improving infant nutrition (Truby King, 1944). His prescriptive methods, which were focused on regularity of sleep, feeding, and bowel motions, were popular well into the 1950s. Whilst the Plunket Society now has a much more attachment based and infant-centred approach to care, notions of 'four-hourly feeding' (and never between 10 p.m. and 6 a.m.) and infants who sleep according to a schedule, remain as a hangover of expectations of how a newborn should behave. Modern day versions of Truby King's approach to infant sleep and care can be found in any general bookstore, providing some parents with exactly the advice they are seeking, and provoking anxiety in others whose infants do not follow the routines and developmental timelines espoused.

Maternal sleep

Sleep in pregnancy

Changes to sleep during pregnancy are widely reported (Hutchison et al., 2012; Lee, Baker, Newton, & Ancoli-Israel, 2008; Pien & Schwab, 2004; Santiago, Nolledo, Kinzler & Santiago, 2001). In the Sleep in America poll of women (National Sleep Foundation, 2007), 79% of women reported that sleep during pregnancy differed from their usual sleep. Anecdotally, researchers and health professionals sometimes liken pregnancy to a massive physiological stress test with almost every aspect of a woman's physiology altered in some way by the reproductive process.

Figure 1 summarises some of the major and most common physiologic and psychologic changes associated with pregnancy. From the outset, sleep quality and quantity are affected by nausea, vomiting, backaches and nocturnal urinary frequency (Hedman, Pohjasvaara, Tolonen, Suhonen-Malm, & Myllyla, 2002; Lee, McEnany, & Zaffke, 2000). As pregnancy progresses sleep is disrupted by foetal movement, leg restlessness and cramps, snoring and shortness of breath (Facco, Kramer, Ho, Zee, & Grobman, 2010). As pregnancy draws to an end, factors of comfort associated with the increasing size of the foetus and uterus, such as difficulty in rolling over and finding a comfortable position, make sleep difficult (Mindell & Jacobson, 2000). Sleep disturbance in the final days before birth can be profound, with mothers in a study of pre-labour sleep experiencing 30% of the night awake and obtaining only 4.5 hours of sleep, on average, in the night preceding labour—regardless of whether women knew labour would commence the following day (because of medical induction) or not (Beebe & Lee, 2007).

Metabolic
Extensive changes to maintain the pregnancy meet the needs of the developing foetus and prepare the mother for birth & lactation

Endocrine
Progesterone
Oestrogen
Relaxin
Oxytocin
Cortisol
Prolactin
Melatonin
Growth Hormone

Psychological
Thinking, worrying, planning, excitement, dreams & hyperarousal

Woman on the delivery stool, from Der Rosengarten, 1513, by Eucharius Rösslin, in Dunn (1998).

Cardiovascular
↑ Heart rate
↑ Cardiac output
↓ Blood pressure

Respiratory
↓ Upper airway
↑ Thoracic cavity
↑ O_2 consumption
↓ Arterial CO_2 pressure

Gastro-intestinal
↑ Nausea, reflux & heartburn
↓ Intestinal motility

Renal
↑ kidney size
↑ filtration rate
↑ urinary frequency
Altered glucose uptake

Reproductive
Breast changes
↑ uterus size
↑ uterine activity
Foetal movements

Muscular-Skeletal
Joint laxity, flaring of ribcage, increasing weight, symphysis pubis pain, back pain, pressure from and movements of foetus

Figure 1. Summary of pregnancy related changes. Items displayed in red can directly impact sleep quality or quantity. Arrows indicate an increase (↑) or decrease (↓) in function or symptoms.

Consequences of sleep changes in pregnancy

Results from a growing number of studies, over the course of the last decade, suggest that sleep disruption during pregnancy is not without consequence. Lee and Gay (2004) studied 131 women in the final weeks of pregnancy. After controlling for infant weight, women in that study who obtained less than 6 hours sleep per night (measured by actigraphy), experienced significantly longer labour durations and were 4.5 times more likely to have caesarean sections compared to women who slept longer than seven hours per night. Sleep quality was also measured actigraphically (as the amount of wake time after sleep onset) and subjectively using a general sleep disturbance scale. Women whose sleep quality was severely disrupted were over five times more likely to give birth by caesarean section. Limitations to this study include that participants were all primiparas and factors such as the use of epidural anaesthesia and the position of the infant prior to and during labour were not controlled for.

Risk of preterm birth has also been found to be associated with disturbed sleep. Self-report questionnaires including the Pittsburgh Sleep Quality Index were completed by 166 women in the first and third trimesters of pregnancy (Okun, Schetter, & Glynn, 2011). Poor sleep quality in both early and late pregnancy was found to be a predictor of preterm labour. Inappropriate inflammatory responses are hypothesised to be one mechanism responsible for triggering such preterm labours. Sleep disturbance is robustly correlated to increased levels of circulating pro-inflammatory cytokines—polypeptides with a role in increasing inflammation in the body, which, when they occur only as a response to a disturbance from sleep, are acting inappropriately in the absence of threat of disease or illness. As previously noted, increased levels of these markers of systemic inflammation also appear to have a causal link to the development of a range of disorders including insulin resistance, cardiovascular disease, and depression. Even modest amounts of sleep loss can induce these changes. Vgontzas et al. (2004) restricted sleep by 25% (from 8 hours to 6 hours) in a group of 25 young, healthy, normal sleepers and observed significant increases in daytime sleepiness, circulating levels of pro-inflammatory markers and decrements in performance (attention and response time).

Alterations to normal sleep during pregnancy do not just have physical consequences. A group of 114 pregnant women seeking treatment for psychological distress completed validated measures of depression (Edinburgh Postnatal Depression Scale; Cox, Holden, & Sagovsky, 1987), worry (Penn State Worry Questionnaire; Meyer, Miller, Metzger, & Borkovec, 1990) and insomnia symptoms (Insomnia Severity Index; Bastien, Vallières, & Morin, 2001). Almost half the participants were assessed as having

insomnia, and 12% were classified as experiencing severe insomnia. Regression analyses showed strong relationships between insomnia symptoms, anxiety and depression, with difficulty falling asleep having the strongest relationship with mood (Swanson, Pickett, Flynn, & Armitage, 2011).

Sleep quality in early pregnancy was found to predict higher levels of depressive symptoms in the third trimester of pregnancy in a study by Skouteris et al. (2008). Starting from 15–23 weeks gestation, 273 women were surveyed at eight-week intervals, completing the Pittsburgh Sleep Quality Index and the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Sleep quality declined across the duration of the study, and higher levels of depressive symptoms were reported at each subsequent time point. Poorer sleep quality scores at the first time-point predicted increases in depression scores at Time 2, and poorer sleep quality scores at Time 2 predicted increased depression scores at Time 3. Depression scores were not found to be predictive of later sleep quality scores.

There is a complex interplay between maternal sleep, depression, anxiety and also physical health. In a study of 257 healthy pregnant women, pregnancy related physical symptoms, poor sleep quality and/or depression in early pregnancy were related to poor sleep quality later in pregnancy, and this poor sleep quality in turn was found to be associated with depression in late pregnancy (Kamysheva, Skouteris, Wertheim, Paxton, & Milgrom, 2010).

Postpartum sleep

Postpartum sleep has been described as "the harshest mixture of most types of sleep disruptions" (Bei, Milgrom, Ericksen, & Trinder, 2010, p. 536). Women are affected by acute or at least significant partial sleep deprivation in the hours and days culminating in childbirth. During labour and birth there is no opportunity for sleep once the contractions of labour have started (Kennedy et al., 2007), and after this sleep, disturbance follows for an extended period of time. Combine this level of sustained and unpredictable disruption with the accumulation of chronic sleep disruption observed across pregnancy and the "harsh mixture" descriptor seems justified.

Few studies have objectively measured alterations in sleep across the immediate peripartum period. Signal et al. (2007) monitored the sleep of 19 healthy women for at least 14 days either side of birth, using actigraphy. In this way the abrupt changes in actual sleep duration, sleep efficiency and number of sleep episodes immediately postpartum were able to be contrasted with antenatal sleep. Mean sleep duration reduced by approximately 1.5 hours from the week preceding labour and birth to the week after, and

the number of sleep episodes in 24-hours rose from 1.5 to 4. By 6–7 weeks postpartum some recovery of pre-birth sleep features had begun but total sleep duration in 24-hours was still less and number of sleep episodes was higher than observed in the same group of women in their second trimester.

Not all women are affected by shortened sleep duration; for some, longer sleep duration may be more problematic. One longitudinal study followed 38 first-time mothers from late pregnancy through to 15 months postpartum, during which time the women kept sleep diaries on four occasions (the third trimester of pregnancy, 2–4 weeks postpartum, 12–16 weeks postpartum, and 12–15 months postpartum). Mothers who reported clinically significant levels of depressive symptoms in the first 4 weeks postpartum also reported significantly different sleep patterns to non-depressed mothers during pregnancy. Depressed women reported later rise times, more naps and longer total sleep duration in the third trimester, although this pattern did not hold in the early postpartum (Wolfson, Crowley, Anwer, & Bassett, 2003).

Women are keenly conscious of any changes to their sleep at this time and the impact this has on their waking lives, with some observers describing it as a behaviour which now, in the postpartum, must be negotiated around the needs of both the infant and the mother (Kennedy et al., 2007). Women's subjective experiences of postpartum sleep, especially the impact of changes on their daytime functioning, have been seen to be significantly related to low postpartum mood (Bei et al., 2010). Women who are affected in this way may try to obtain more sleep by increasing daytime napping. However, because of the circadian processes at play, this sleep does not provide the same restorative benefits as sleep obtained at night.

Consequences of postpartum sleep changes

Sleep disturbance after birth has been associated with maternal fatigue, daytime sleepiness, postnatal depression (Goyal, Gay, & Lee, 2009), bipolar disorder and post-partum psychosis (Sharma & Mazmanian, 2003).

One of the most commonly reported consequences of sleep changes in the postpartum period is maternal fatigue (Dennis & Ross, 2005; McQueen & Mander, 2003). The construct of fatigue is not always clearly defined, but two useful definitions may be applied—the first has particular salience in occupational settings, and the second may be more applicable in understanding health and well-being in the general and clinical populations:

Fatigue is the result of work demands exceeding current performance capacity, due to inadequate recovery opportunities, particularly for sleep. (Gander, Graeber, & Belenky, 2011, p. 760).

Fatigue is an overwhelming sense of tiredness, lack of energy and a feeling of exhaustion, associated with impaired physical and/or cognitive functioning; which needs to be distinguished from symptoms of depression, which include a lack of self-esteem, sadness and despair or hopelessness. (Shen, Barbera, & Shapiro, 2006, p. 70)

Goyal et al. (2009) found that women who sleep less than 4 hours at night (between midnight and 6 a.m.) or women who napped less than 60 minutes per day at three months postpartum were at significantly increased risk of postpartum depression. Women who reported difficulties falling asleep on a sleep disturbance scale were particularly at risk of postpartum depression.

Relationship satisfaction is known to decline after birth (Delmore-Ko, Pancer, Hunsberger, & Pratt, 2000; Shapiro, Gottman, & Carrére, 2000) and it appears that poor sleep and perception of sleep has a role to play in this process (Insana, Costello, & Montgomery-Downs, 2011). Couples completed actigraphy, mood and relationship measures, as well as keeping sleep diaries for one week, when they were between 3–8 weeks postpartum. Greater sleep duration was associated with increased relationship satisfaction, and more accurate perception of their partner's sleep state enhanced feelings of support in the new parents (Insana et al., 2011).

A report from the United States of America's National Institute of Health noted that 75% of sleep research has had men as the subjects (National Heart Lung and Blood Institute, 2003). Few studies have investigated the neurobehavioural consequences of altered sleep during pregnancy and postpartum and existing research has tended to focus on factors such as mood, birth outcome and daytime sleepiness. Several studies have investigated perinatal memory function—possibly in response to common complaints from women (and their partners) about so called 'preggy brain' or 'nappy (diaper) brain' (see Henry & Rendell, 2007 for a review). These studies have not produced consistent results, although it does appear that, in general, perinatal women do experience memory difficulties, but in differing aspects of memory function.

Until recently the question of whether perinatal women are somehow immune to or protected from other negative neurobehavioural effects of sleep disturbance observed in the non-perinatal population has not been investigated. Insana et al. (2013) studied 70 first-time mothers during the first 12 weeks postpartum. Women wore wrist actigraphs and completed the psychomotor vigilance test (PVT) each morning within two hours of

waking. The PVT is recognised as having high ecological validity with everyday tasks requiring attention and quick response performance. Despite an increase in total sleep time across the course of the study, neurobehavioural performance worsened from 2–12 weeks postpartum. The authors concluded that this degradation in performance is likely to be as a result of the cumulative impact of sleep disturbance (reduced normal sleep duration and increased sleep fragmentation).

The neonatal period (first 4–6 weeks) requires intensive parenting from mothers and fathers. First-time mothers need to acquire new skills, learn to observe their infant's unique needs and ways of communicating, and both novice and experienced mothers may be learning important caring skills if they have an infant with high or special needs (Lee & Zaffke, 1999; Lee & Lee, 2007). In New Zealand, the provision for paid parental leave is currently 14 weeks, and given these findings, women are also likely to be affected by considerable impairment to attention and reaction speed at a time when many are returning to paid employment. The question of how long it takes before full recovery of neurobehavioural performance occurs is yet to be answered.

Infant sleep

Since the main source of disruption to postpartum sleep comes from the newborn, an understanding of infant sleep development should inform expectations and interventions. There is now robust evidence that sleep, like language, involves a developmental pattern of neural organisation which expresses itself in a programmed way (Hoppenbrouwers et al., 2005; McGraw, Hoffmann, Harker, & Herman, 1999). These developments in the brain and internal biological clock happen within each individual infant's wider environment so the process of sleep development is seldom the same between one infant and the next. Organised sleep-wake behaviour will, in time, emerge for the healthy infant, however, the progression of sleep development varies for individuals, even those sharing identical genetic material and the same environment, such as is the case for conjoined twins (Hoppenbrouwers et al., 2005).

From the moment an infant arrives in the world the process of separating and differentiating from the biological mother commences. Within hours the infant's own homeostatic processes must rise to new levels and begin controlling such basic physiologic needs as thirst, hunger, temperature regulation, excretion and sleep. Prior to this event, though, the infant has been subject to aspects of the mother's circadian and endocrine rhythms.

Cycles of irregular electrical brain activity begin between weeks 20–28 gestation in the human foetus (Graven & Browne, 2008). By about 28 weeks' gestation more distinct

electrical patterns of sleep states emerge and by 30 weeks' gestation EEG patterns of REM and NREM appear. Rapid eye movement sleep is considered critical to the foetal development of sensory systems including touch, hearing, emotion and memory (Penn & Shatz, 1999). Sleep cycles involving REM and NREM sleep are also thought to be critical aspects of brain plasticity—"the capacity to change, adapt, and learn in response to environmental experiences and new needs" (Graven & Browne, 2008, p. 174). The cellular processes associated with lifelong brain plasticity begin in-utero (Peirano & Algarín, 2007) in response to REM sleep (Graven & Browne, 2008).

Circadian rhythmicity is most strongly entrained by photic information (light/dark cycles) and it appears that this system is active even in very premature infants (Rivkees, 2003). Prior to birth, day-night rhythms are likely to be driven in the foetus by the mother (Rivkees, 2003). Although some infants show evidence of developing a day-night rhythm as soon as one week after birth, most are likely to achieve this milestone between one and three months of age (Rivkees, 2003). Activities of the mother (or other close caregiver) may also support the onset of circadian rhythmicity including breastfeeding, timing of interactions and having the infant nearby to continue exposure to the rhythms which are familiar from life in-utero (Graven & Browne, 2008). Melatonin crosses the placenta in-utero, and endogenous production is not evident in the newborn until approximately six weeks postpartum (McGraw et al., 1999). Breastmilk contains melatonin, and this may support nocturnal sleep development in the newborn, particularly during the period when melatonin production in the infant is not yet fully established (Cohen Engler, Hadash, Shehadeh, & Pillar, 2012; Kimata, 2007).

The homeostatic drive for sleep in neonates is such that the infant only has brief periods of waking and alertness. These can be extended somewhat through exposure to bright light (McGraw et al., 1999) or interaction with a caregiver who might alter the infant's posture or provide visual or auditory stimuli (Peirano & Algarín, 2007), however, missed signs of disengagement and readiness for sleep can lead to an overstimulated and difficult to settle infant (Barnard, 1999; NCAST, 2008). By two months of age, the infant gains more coordinated and goal-directed control of his or her body. Achievement of these developmental steps is associated with an increase in alertness, and daytime waking (Peirano & Algarín, 2007). Circadian rhythms in waking are observed by approximately six weeks postpartum, while circadian rhythms in sleep appear later by approximately eight weeks postpartum (McGraw et al., 1999).

Functions of sleep in the newborn

Actual REM sleep is not fully developed at birth and is described in infants as active sleep, while NREM sleep is described as quiet sleep. A third state of indeterminate sleep is also observed in newborn EEG records. Active or REM-like sleep patterns have been observed prenatally in the human foetus, and in contrast to adults, the newborn enters sleep through an active sleep stage, spending approximately twice as much time in active sleep compared to adult time spent in REM sleep (Roffwarg, Muzio, & Dement, 1966). This pattern is hypothesised to be strongly linked to central nervous system development, especially visual development (Peirano & Algarín, 2007). NREM sleep is no less important at this time and a growing body of evidence suggests that quiet, NREM-like sleep is associated with reactivating information gathered during waking for reprocessing, learning and memory consolidation (for a review, see Tarullo, Balsam, & Fifer, 2011).

The human newborn sleeps on average between 14–16 hours per day, although sleep duration may range from 9–19 hours per day (Burnham, Goodlin-Jones, Gaylor, & Anders, 2002; Iglowstein, Jenni, Molinari, & Largo, 2003; Wooding, Boyd, & Geddis, 1990). Typically the newborn sleeps for a maximum of three hours at any one stretch (Burnham et al., 2002). The need for frequent feeding, a propensity to startle and arouse easily from quiet, deep sleep, and a total reliance on others to provide the basic necessities of life (including emotional and physical comfort), engage the infant's primary caregivers in high levels of interaction throughout the day and night.

By about six weeks of age the capacity to remain awake for longer periods during the day has developed and this appears to precede the ability to maintain sleep for longer stretches at night (Coons & Guilleminault, 1982; McGraw et al., 1999). Understanding that infants arouse easily when transitioning between sleep stages, that infants enter sleep through active sleep, and that active sleep in an infant is, indeed, very active, may be informative for parents. During active sleep, infants in the first few months may appear to be awake or waking up. They may vocalise, open their eyes and make many more movements than in quiet or indeterminate sleep stages (Dittrichová, 1966; Keener, Zeanah, & Anders, 1988). An informed parent may be in a better position to decide whether and when to observe and intervene in their infant's sleep/waking cycles, however, this information is seldom made available to parents in the antenatal period, and if it is given at all in the postnatal period, it is not likely to be in the very early weeks after birth, when it would be most useful (Dwyer, 2009).

One way to understand the complex and dynamic relationship sleep has with an individual's environment is through a transactional or systems model (Sadeh & Anders, 1993). Transactional models assume that the participant and their biopsychosocial

context interact to give rise to symptoms, such as poor sleep, reduced mental health or relationship problems. A common goal for parents is that their baby learns to sleep 'through the night' at the earliest age possible and there may be significant parental concern if this milestone is delayed (Sadeh & Anders, 1993). While it seems that sleep maturation can occur in a predictable way over time, there are also things that parents do to either help or hinder the development of healthy sleep habits in their infant.

A transactional model of infant sleep development (Figure 2) has been developed to describe how infant biology, maturity and temperament interact with environmental factors such as parenting style and beliefs, cultural location and socioeconomic and relationship pressures on a family, to help or hinder sleep development (Sadeh & Anders, 1993; Sadeh, Tikotzky, & Scher, 2010). Knowledge of these interactions and associations may be useful in helping parents develop realistic expectations about how and why their infant's sleep develops in a unique way (Tikotzky & Sadeh, 2009). This model may also be useful in demonstrating points in the system where parents might help or hinder the process, such as through the timing, type and length of bedtime interactions (Sadeh & Anders, 1993).

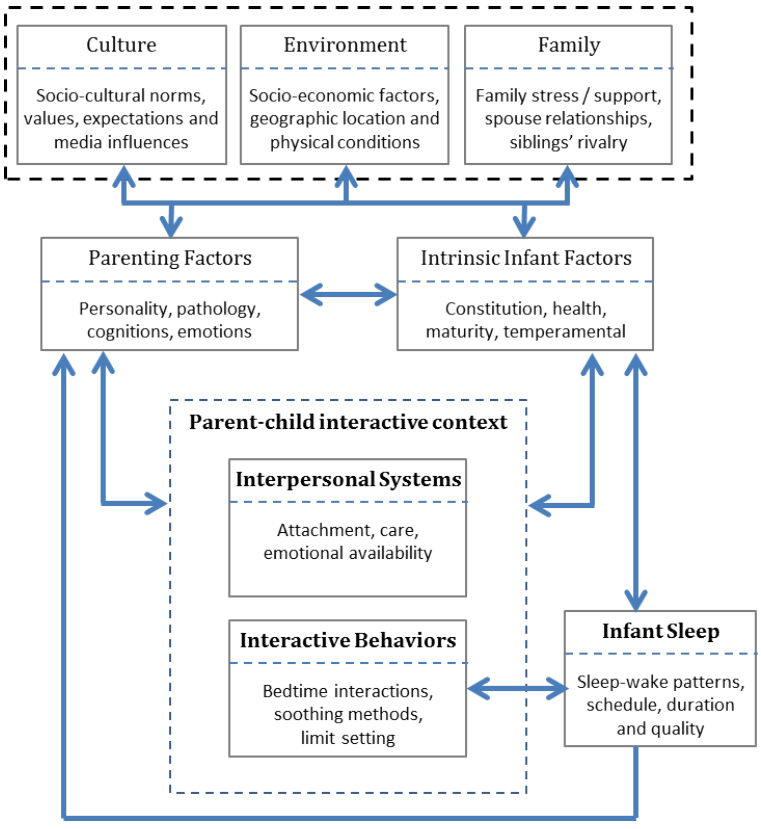

Figure 2. Transactional model of infant sleep development (Sadeh, Tikotzky & Scher, 2010)

The issue of infant sleep is commonly discussed at postnatal education classes and well-child visits. In a recently published study of infants sleep across 17 countries, 30% of New Zealand parents surveyed (n=1081) reported their infant or toddler's sleep to be a problem (Mindell, Sadeh, Wiegand, How, & Goh, 2010). The largest provider of well-child services in New Zealand, including a 24-hour telephone helpline, is Plunket. Care delivery is categorised according to the type of assistance nurses give to parents and the 'child behaviour' care delivery component encompasses sleeping, crying, unsettled baby, colic, toilet training, tantrums, social development, and behavioural issues. Assisting parents with child behaviour makes up 77% of the contact Plunket nurses have with parents of children under 5 years of age (A.M. Morris, Clinical Leader, Plunket, personal communication, 27 November 2013). Although data is not captured specifically about sleep assistance, nurses report that the majority of the child behaviour assistance is sleep related. Few studies have been published about infant sleep development or infant sleep problems in New Zealand families, although much literature emanates from New Zealand (for examples see Gunn, Gunn, & Mitchell, 2000) about infant sleep and its relationship to sudden infant death syndrome (SIDS).

Overseas studies have repeatedly shown that infant sleep problems are associated with adverse outcomes for both the infant and their parents. Sleep problems which emerge in infancy and persist into the preschool years can become chronic. Sleep disruption and/or deprivation can negatively affect children's cognitive development, mood regulation, attention, behaviour, health and overall quality of life (Mindell, Kuhn, Lewin, Meltzer, & Sadeh, 2006). Adverse outcomes for parents include poor maternal physical and mental health, paternal depression and adverse pressure on parental relationships (Hiscock, 2009). Problems with sleep in infants and young children have also been associated with decreased relationship satisfaction (Meijer & van den Wittenboer, 2007), child behaviour problems, child abuse (Kerr & Jowett, 1994) and maternal anxiety (Matthey & Speyer, 2008).

Childbirth educators and midwives are in a position to offer parents evidence-based information on infant sleep development, give normative sleep data, and share a range of strategies to help inform parents about what to expect and how to manage sleep after birth. Neither group receives any formal training about managing sleep (either maternal or infant) in New Zealand. Community well child nurses are likely to be more informed on this topic, however, women and infants do not come under their care until at least 4–6 weeks postpartum.

Behavioural sleep interventions are often targeted at infants aged 6 months or older, when attachment, feeding and sleep-wake patterns are more firmly established (France,

Blampied, & Henderson, 2003). Parents of younger infants may wish to try such strategies as leaving their infant to cry themselves to sleep, or offering intermittent comfort to a baby in a self-settling process, but these strategies are not necessarily acceptable to all parents with young infants (Blunden, Thompson, & Dawson, 2011; Middlemiss, 2004; Tse & Hall, 2007). There is, therefore, a gap in support for parents in the early postnatal period when it comes to expectations around sleep development, as well as knowing how to cope with their own and their infant's sleep. A non-prescriptive, flexible approach that can be tailored to the family's unique context may be acceptable in the early weeks and months. Offering a range of strategies and information, so parents have a tool-box of ideas to draw upon, increases parental choice. Ensuring what is offered is evidence based may help parents in the face of potentially overwhelming, well-meaning advice from friends and family, or the plethora of infant sleep books and internet guides, which, in a number of cases have been written by self-professed 'sleep experts' and 'baby whisperers', based on their individual experience as either a nanny or mother.

Mood

Many fears are born of fatigue and loneliness.

From the *Desiderata*, Max Ehrmann, 1927

The World Health Organisation places unipolar depression in third position on its list of top ten disabling conditions affecting high income countries, including New Zealand. Depression is ranked ahead of other headline-grabbing conditions including ischemic heart disease, cerebrovascular disease and diabetes. It is predicted that by 2030 unipolar depression will top this list for all countries across low, medium and high income rankings (World Health Organisation, 2008). Women of childbearing age are also affected by a higher degree of burden from neuropsychiatric conditions, especially depression (see Figure 3).

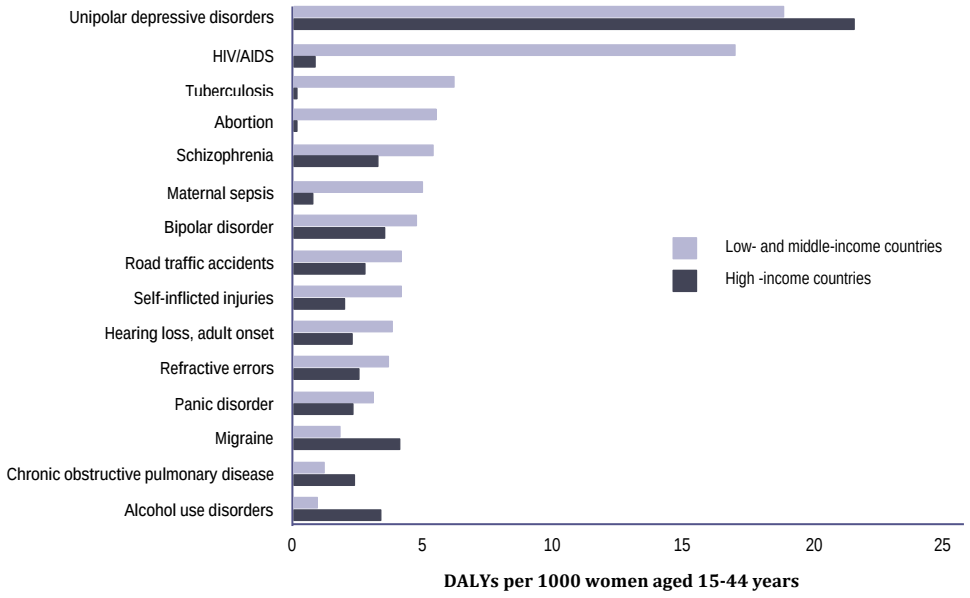

Figure 3. Leading causes of disease burden for women aged 15-44 years, grouped as low and middle income countries (combined), and high income countries. Source: *The Global Burden of Disease: 2004 Update*, World Health Organisation, Geneva. The DALY is a metric used to quantify burden of disease by combining years of life lost through premature death and years of life lived with disability or disease for each incident of a specified condition (Mathers, Vos, Lopez, Salomon, & Ezzati, 2001).

The lifetime prevalence for any mood disorder in New Zealand is 20.2% (95% CI = 19.3-21.1), with the highest prevalence of mood disorders occurring between the ages of 16 to 44 years (21.9%, Ministry of Health, 2006). Women (24.3%) are more likely to

experience a mood disorder during their lifetime than men (15.6%), with the highest prevalence falling in the childbearing years.

Mood disorders are often comorbid with anxiety disorders. The lifetime prevalence for any anxiety disorder in New Zealand is 24.9% (95% CI = 23.6 – 26.2, Ministry of Health, 2006), with the highest prevalence also occurring between the ages of 16-44 years (35.9%). Again, women are more likely than men to be affected by an anxiety disorder during their lifetime (women = 29.4%, men = 19.9%). *Te Rau Hinengaro: The New Zealand Mental Health Survey* (Ministry of Health, 2006), a nationally representative survey involving almost 13,000 people over the age of 16 years, found that 49.6% of people who reported any mood disorder also reported having an anxiety disorder (12 month prevalence). Mood and anxiety disorders were also found to be associated with suicidal ideation, suicide plans, and suicide attempt in 11.8% of people reporting any mental disorder. Suicidal ideation, plans and attempts were consistently significantly higher for females compared to males, and rates of plans and attempts were higher for Māori and Pacific people than other ethnicities.

In New Zealand, the most common cause of maternal mortality is suicide. Absolute numbers of women who have completed suicide in the years 2006-2011 are small (n = 14) however, with the exception of the general classification of pre-existing medical condition (n = 15), this total is higher than all other causes of maternal death including amniotic fluid embolism, pre-eclampsia/eclampsia and sepsis (Perinatal and Maternal Mortality Review Committee, 2013). Method of suicide is not reported in the New Zealand maternal mortality data, however, a similar enquiry in the United Kingdom found that 87% of women who completed suicide in the years 2006-2008 did so using violent means including hanging, jumping from a height and self-immolation (Centre for Maternal and Child Enquiries, 2011).

Criteria defined by the American Psychiatric Association's (APA) *Diagnostic and Statistical Manual of Mental Disorders, 4th edition, revised* (DSM-IV-TR, American Psychiatric Association, 2000) provide a common classification system and starting point for research focused on mental health and disorders[2]. Symptoms used to diagnose a major depressive episode include: depressed mood (including feel sad or empty); diminished interest in usually pleasurable activities (anhedonia); significant weight loss or gain or decrease/increase in appetite (not associated with dieting); insomnia or hypersomnia, psychomotor agitation or retardation; fatigue or energy loss, feelings of worthlessness or excessive or inappropriate guilt; difficulties with thinking, concentrating, decision making;

[2] It is acknowledged that the DSM-5 was published by the APA in May 2013. The criteria for major depressive disorder are unchanged between the DSM-IV-TR and the DSM-5.

suicidal ideation, plans or attempts. Five or more of these symptoms should be present on most days during a two week period, and reflect a change from previous or usual functioning to diagnose major depression. Depressed mood and/or anhedonia are key features of the DSM classifications of depressive disorders and are sufficient criteria to diagnose minor depression (along with the presence of any of the other major episode symptoms, but no more than five when diagnosing minor depression).

Postnatal mood

Depending on the criteria used, research suggests that most women will experience at least mild affective disturbance after birth (Buttner, O'Hara, & Watson, 2012), with postnatal mood disturbance falling into three main classifications, in ascending order of severity: postpartum 'baby blues', postpartum depression and puerperal/postpartum psychosis.

The postpartum blues are characterised by mild mood disturbance, often expressed as feeling and being tearful, emotional lability (with quick changes of mood up and down), and feeling especially sensitive (Buttner et al., 2012). Onset occurs in the first week to ten days after birth, and prevalence is estimated at between 15 to 84% (Henshaw, 2003). While the term 'blues' is indicative of low mood, women report cycling between elation (sometimes referred to as the 'pinks') and despair in quick succession; sometimes weeping without any concurrent feelings of sadness or depression (Henshaw, 2003). These symptoms are typically evident by the third day postpartum, lasting from several hours to days, and usually remit by seven to ten days. Symptoms have been reported to peak on postpartum days three and five (Kennerley & Gath, 1989). While the blues tend to pass as spontaneously as they occur, without the need for intervention, they are considered a risk factor for postpartum depression, particularly when severe or prolonged (Henshaw, Foreman, & Cox, 2004; Pearlstein, 2008).

At the other end of the spectrum a small number of women (approximately 1–2:1000) develop a severe mood disorder after birth in the form of puerperal psychosis. Puerperal psychosis has a clear temporal relationship with the birth event, with onset typically occurring as quickly as three days and up to four weeks postpartum (Boyce & Barriball, 2010). Puerperal psychosis is considered a psychiatric emergency, often requiring hospitalisation to manage symptoms which can include grandiose, paranoid or bizarre delusions, hallucinations, disorganised behaviour, and mood swings. Auditory hallucinations are often of a 'command' nature and can include instructions to the mother to harm herself or her infant (Sit, Rothschild, & Wisner, 2006). A strong relationship exists between puerperal psychosis and bipolar disorder in which case the risk rate is more like

1:7. The aetiology of puerperal psychosis remains unclear, however, among other factors (such as rapid decline in hormones of pregnancy), disruption to the sleep/wake cycle has been implicated as a precipitating factor in onset of puerperal psychosis (Sit et al., 2006). Monitoring of the sleep/wake cycle during pregnancy, in women with a history of mood disorder, has been recommended, as well as actively planning to manage sleep in the early postpartum as a protective strategy (Sharma & Mazmanian, 2003).

Somewhere between the blues and puerperal psychosis lies postpartum depression, a non-psychotic form of depressive disorder. In addition to the general criteria for major depression, the DSM-IV provides for a specifier of 'postpartum onset'. Additional symptoms may be present with this specifier, such as mood lability and preoccupations with the infant's health. The DSM-IV Postpartum Onset Specifier also prescribes that onset should be within four weeks of birth[3]. This specifier has proved, in practice and in research, to be considered too limited, and the less restrictive definition of 'perinatal depression', including major and minor depressive episodes occurring either in pregnancy or up to one year after childbirth, has become widely accepted (Gavin et al., 2005; O'Hara, 2009).

A widely cited meta-analysis of 59 studies, involving 12,810 participants, noted that features of postnatal depression include depressed mood, hopelessness, anxiety, excessive fatigue, psychomotor agitation, appetite and sleep disturbance, guilt and/or feelings of inadequacy (O'Hara & Swain, 1996). This same review reported the prevalence rate of postnatal depression to be 13%. The authors also found that, while there was a significant difference between self-reported prevalence (14%) and prevalence determined by interview (12%), the absolute difference between the two methods was small. A more recent comprehensive systematic review of 28 prospective studies of postnatal depression, involving 14,835 women, found the period prevalence rate of women having a major depressive episode in the first three months postpartum to be 19.2% (Gavin et al., 2005). The Gavin et al. (2005) review excluded studies reporting prevalence of depression based solely on self-report, based on the potential for self-reports to overinflate prevalence estimates. Evidence of perinatal depression had to have come from either clinical assessment or a structured clinical interview, but could include self-report measures as well.

Few studies have investigated the prevalence of perinatal depression in New Zealand, and those that have were carried out in populations defined either by a limited geographic area, or within particular ethnic groups. One study of 1,376 mothers, who self-

[3] This specifier remains unchanged in the DSM-5.

identified as being of Pacific Island ethnicity, reported prevalence to be 16.4% when women completed the Edinburgh Postnatal Depression Scale (EPDS) at six weeks postpartum (Butler, Williams, Tukuitonga, & Paterson, 2003). A smaller, community study of women in Auckland (*n* = 206, Māori = 8% and non-Māori = 93%), reported that 7.8% of women met the clinical criteria for major depression and 21.5% met the criteria for minor depression using the EPDS (Webster, Thompson, Mitchell, & Werry, 1994). In that study, the mean EPDS score was higher for Māori (8.6%) than non-Māori women (5.8%), at four weeks postpartum. Postnatal depression was associated with being single, less than 20 years old at the birth of the first child, having an unhappy partner relationship, having a history of previous psychiatric hospitalisation and being Māori. This, and one other study by Holt (1995), found that symptoms were often present for some time, yet, women were reluctant to raise their distress with their doctor or health worker, especially in the most severe cases.

Women in Christchurch, New Zealand (*n* =1,330) completed questionnaires between six to nine months postpartum, and 20% were found to be depressed (McGill, Benzie Burrows, Holland, Langer, & Sweet, 1995). Using multiple regression, the authors identified a range of factors which were significantly associated with postnatal depression. These were: experiencing depressive symptoms before, during and since pregnancy; deterioration in partner relationship; decreases in energy, confidence, and happiness after pregnancy; a history of moderate or severe pre-menstrual symptoms prior to pregnancy; low levels of education and income; and frequent nausea and low spirit in late pregnancy. In this sample, 10% of non-depressed women reported sleeplessness. Depressed women were categorised as those scoring 12/13 on the EPDS and those scoring 14 or above. In the group scoring 12/13, 33% reported sleeplessness while 41% of those scoring above 14 reported sleeplessness. Of the non-depressed women, 14.3% reported symptoms of anxiety (feeling keyed up), whereas 42% of 12/13 depressed group and 48% of 14 or over depressed group reported anxiety symptoms.

While the comprehensive meta-analyses described (Gavin et al., 2005; O'Hara & Swain, 1996) document prevalence rates of postnatal depression ranging from at least 13% to 19%, it is likely that many more women are struggling with problems which may be clinically regarded as less severe but nonetheless are distressing. For instance, a study of maternal health after birth, including 1,336 women, found that 94% of women experienced one or more health problems in the first 12 months after childbirth including tiredness, backache, incontinence, gynaecological and sexual dysfunction, and emotional problems (Brown & Lumley, 1998). At six months postpartum 16.9% of women in the study were classified as depressed (scoring greater than 13 on the EPDS) while 27%

reported emotional problems including feeling depressed and anxious. One quarter of women who reported any health problem in the survey had not discussed it with their health professional and one in seven women had not talked to anyone at all about their problems. It appears many women suffer in silence when it comes to their perinatal health with 49% of women in this study reporting that they would like to have been given more health-related advice and help.

Perinatal mood and sleep

Theoretical frameworks

Three frameworks—the 5-part model, the 3 Ps model and the transdiagnostic approach—will be used to contextualise the relationship between sleep and mood in the peripartum period. The 5-part model is widely used in cognitive-behavioural therapy (CBT) conceptualisations of psychological problems (Padesky & Mooney, 1990). This model infers that human experiences comprise a whole system made up of the component parts of physiology, cognitions, behaviours and emotions, set within an individual's unique context or environment. The 3 Ps model, has appeared in the psychological literature for at least the last sixty years (Lewis, 1948; Sulzberger & Zaidens, 1948). The 3 Ps model is used by psychiatrists, psychologists and other therapists, as part of a framework for case conceptualisation—the process of integrating information about an individual's problem with factors that may have *predisposed* the individual to the current problem, events or factors that have *precipitated* the current problem, and factors which are maintaining or *perpetuating* the current problem, all of which then informs the way forward such, as through some form of intervention. The 3 Ps model has been integrated into insomnia treatment models, in particular cognitive behavioural therapy for insomnia or CBTi (Spielman, 1986; Spielman & Glovinsky, 1991).

Multiple studies have found a relationship between poor sleep and poor mood (see Harvey (2011) and Lee and Douglass (2010) for reviews). That a relationship between sleep and mood exists seems unequivocal but the direction of that relationship is less clear. Increasingly, this relationship is understood as being bidirectional in nature. Recent psychological research and practice are also taking a 'transdiagnostic' approach such that individual psychological disorders are not ring-fenced for discrete disorder-specific investigation or treatment. The goal of a transdiagnostic approach is to understand mechanisms which are common to disorders that co-occur, for instance, sleep disturbance as a mechanism shared by and maintaining insomnia and mood disorders, (Harvey, Murray, Chandler, & Soehner, 2011) or repetitive negative thinking as a transdiagnostic process in insomnia, depression and anxiety disorders, all of which are frequently

comorbid (Ehring & Watkins, 2008). As well as mood and anxiety disorders, sleep disorders are commonly comorbid with substance abuse, impulse control disorders and increased risk of suicide (Roth, 2009). Taking this perspective, any preventive or treatment approach which addresses perinatal sleep disturbance has the potential to offer protective value against mood, anxiety and other disturbances to well-being.

A 5-part model of perinatal mood and sleep disturbance

Theoretical frameworks cannot always adequately encapsulate the variability of human beings and their activities. The following application of the 5-part model is therefore not intended to be an exhaustive account of the interaction of perinatal mood and sleep disturbance, rather, it summarises key theoretical contributors to the relationship between sleep and mood.

Physiology

Disturbances to sleep and circadian rhythms are common features of mood disorders serving as both precipitating (triggering) and perpetuating (maintaining) factors (Harvey, 2011; Wirz-Justice, 2006). Even after treatment of depression, disturbed sleep is one of the most common residual symptoms, and the continuation of this disruption increases risk of relapse (Harvey, 2011). Myriad biological processes appear to be affected in depressed individuals including sleep/wake cycles, temperature, melatonin, norepinephrine and cortisol rhythms, and timing of glucose metabolism in the brain (Germain & Kupfer, 2008).

Disturbances to biological rhythms have long been associated with mood disorders (Wirz-Justice, 2006) and recent scientific advances have begun to unpack these complex relationships. For instance, the SCN has been found to be densely innervated with serotonin neurons which appear to play a role in the entrainment of the circadian biological clock by light (Moore & Speh, 2004). The highest concentrations of central nervous system serotonin are found in the SCN and this neurotransmitter has an influence on circadian rhythmicity. Advances in the efficacy of antidepressant drugs which target norepinephrine and serotonin receptor activity lend support to the role that these neurotransmitters also have in regulating mood (Sadock & Sadock, 2007). Bright light therapy has been found to be beneficial in treating seasonal affective disorder, bulimia and antenatal depression. It appears that the stability in the timing between circadian processes (such as cortisol and melatonin production) and the timing of sleep in line with the day-night cycle, are essential components of stable euthymic mood (Wirz-Justice, 2006).

Zeitgebers (translated as 'time givers') are environmental cues with a role in maintaining biological rhythms with the strongest zeitgebers being light. Other zeitgebers that ensure the stability of, or potentially disrupt, circadian processes include social rhythms such as bed and rise times, meal times, work schedules and the timing of other activities of daily living, such as showering, exercise (Ehlers, Frank & Kupfer, 1988; Grandin, Alloy, & Abramson, 2006; Meyer & Maier, 2006; Monk, 2010) and potentially even child care tasks like breastfeeding.

It is plausible that changes to physiology and to usual sleep timing and duration during the perinatal period result in alterations to circadian rhythms. Usual timing in the master circadian pacemaker (the SCN) may shift, either advancing or becoming delayed, in response to changes in sleep/wake behaviours in pregnancy or the postpartum. This may cause a cascade of related changes to the circadian rhythms regulating temperature, cortisol and melatonin production, and the timing of REM sleep, all of which have been associated with depression (Germain & Kupfer, 2008). Resetting these phase shifts is hypothesised as the likely cause of improvement in people with depressive symptoms who respond positively to manipulation of the timing or duration of their sleep (through partial or total deprivation), or to bright light therapy (Wirz-Justice, 2006).

When it comes to perinatal women, research in this area is in its infancy. Most recently 12 women with a history of major depressive disorder were studied from the third trimester of pregnancy to six weeks postpartum (Sharkey, Pearlstein, & Carskadon, 2013). Participants kept sleep diaries and completed wrist actigraphy (with light sensors), mood scales and provided saliva samples in late pregnancy and at six weeks postpartum to determine changes in the circadian rhythms of melatonin production. Seven of the 12 participants experienced large changes in their circadian rhythms equivalent to at least a one time-zone change or the change associated with shifting to or from daylight saving time. Further, these changes—described as a form of postpartum jetlag—were correlated with postpartum depressive symptoms.

The limbic system, which includes the amygdala, plays a role in attention, motivation, memory, affective processing, evaluation of the salience of information, and the creation and experience of emotion (Cohen, Malloy, Jenkins, & Paul, 2006). Functional MRI scans comparing healthy sleep deprived individuals (35 hours awake) and healthy, non-sleep deprived controls have shown exacerbated limbic response to negative emotional stimuli in the sleep deprived group. Functional connectivity between the amygdala and the prefrontal cortex was also impaired in the sleep deprived group, suggesting that pre-frontal control is diminished which may affect an individual's capacity

to make plans and appropriate behavioural choices and responses in daily life (Yoo, Gujar, Hu, Jolesz, & Walker, 2007).

Alterations to neurotransmitter activity and pathways are widely implicated in the pathophysiology of depression (Sadock & Sadock, 2007); The hypothalamic-pituitary-adrenal (HPA) axis is a neuroendocrine system associated with stress, and over-activation of the HPA (evidenced through increased corticotropin-releasing hormone and cortisol levels) is also associated with sleep disturbance and depression (Harvey et al., 2011; Novati et al., 2008).

Lastly, as previously described, increased inflammation is emerging as an important mechanism associated with sleep, stress, depression and adverse pregnancy outcomes including hypertension, pre-eclampsia, gestational diabetes and depression (Okun, Roberts, Marsland, & Hall, 2009; Qiu, Enquobahrie, Frederick, Abetew, & Williams, 2010).

Behaviour

New activities related to parenting, like feeding and providing around-the-clock care and nurturance to a newborn, as well as changes to usual behaviours such as regular bed or rise times, changes to meal and recreation or physical exercise patterns (including exposure to daylight) all have the possibility of affecting circadian rhythms, neurotransmitter production, sleep and mood. Postpartum sleep-related behaviours may ultimately precipitate or perpetuate a decline in mood, or act to protect a woman from mood disturbance, by promoting, as much as is reasonable, the opportunities for sleep of sufficient quality and quantity.

Social and culturally defined behaviours influence sleep including the practice of co-sleeping, which may have benefits such as facilitating night breastfeeding, increasing synchrony between the mother and infant (which is hypothesised to be protective of sudden unexpected death of infants), whilst simultaneously being associated with increased maternal sleep fragmentation (McKenna & Mosko, 1994; Thoman, 2006). In the contemporary world of parenting, technology plays an increasing role in parental monitoring behaviours, such that parents can now use audio and video monitors to check on their infants, as well as keep track of their own and their infant's sleep behaviours using Smartphone applications (see www.dragoninnovation.com/projects/19-mimo for an example). The effect of such technologies is yet to be tested, however, it could be hypothesised that, in a parent who is already anxiously predisposed, these technologies may serve to reinforce hyper-vigilant and compulsive behaviours, and obsessive and repetitive thinking.

Postpartum opportunities for sleep may not be maximised by women, even when their infant is sleeping, as attempts are made to keep on top of household tasks or have time for self. Women are often encouraged to sleep when the baby sleeps but, even if motivated to prioritise sleep in this way, women may find daytime sleep difficult if they are in a circadian phase of reduced sleep propensity (wake maintenance zone).

Opportunities and motivation to be physically active may be reduced in the postpartum because of fatigue and the need to prioritise infant care over other tasks. Physical activity, including walking, has been positively associated with improving both sleep (Atkinson & Davenne, 2007) and depression (Ströhle, 2009) in the general population, and in the perinatal population (Davis & Dimidjian, 2012) .

During the early postnatal period, women may have reduced opportunities to engage in activities which give pleasure or involve mastery (a sense of achievement). Reducing time spent in such activities has been associated with the risk or maintenance of depression, and can also be associated with social withdrawal and excessive periods of time in bed (Dimidjian, Barrera, Martell, Muñoz, & Lewinsohn, 2011). In order to increase understanding in this area, behavioural activation, defined as "increasing pleasant activities", is being utilised in an internet based treatment programme for women with postnatal depression (Danaher et al., 2012).

Finally, behaviour often involves choice and choice of bed time and rise time can impact the opportunity available for sleep. New mothers may previously have given little conscious thought to needing to control or create sleep opportunities, but once faced with sleep deprivation and the relentless demands of parenting, they find that negotiating with others to help them prioritise sleep opportunities (including naps and earlier than usual bed or later rise times) is an essential coping behaviour (Kennedy et al., 2007). Women with limited social support will find it more difficult to prioritise sleep in this way. It can also be hypothesised that women with rigid thinking styles, who are endeavouring to hold onto control of the new situation, by not giving-in and altering their own sleep habits, may also find it difficult to prioritise sleep in this way.

Cognitions

Cognitive contributions to perinatal sleep may come in many forms, including beliefs and attitudes held about sleep as a human activity and the importance of sleep for physical and psychological health; sleep-related knowledge, including understanding of the basic processes of sleep and what might help or hinder the achievement of restorative sleep; as well as cognitive processes like repetitive thinking. For a mother, cognitions will relate not

just to herself, but to her infant, and possibly her partner and other children as well (Insana et al., 2011; Tikotzky & Sadeh, 2009).

Pregnant and postpartum women commonly report that their thoughts interfere with sleeping or that they have difficulty falling asleep or going back to sleep after awakening in the night (Mindell & Jacobson, 2000; National Sleep Foundation, 2007). Anecdotally, women also report that they have trouble switching off a busy mind, or not feeling stressed but just wide awake and thinking, when they would rather be sleeping.

Beck has identified relentless obsessive thinking as a prominent symptom for women affected by postpartum depression (Beck, 2006). Repetitive thinking is a commonly occurring cognitive process of humans which has been defined as *"the process of thinking attentively, repetitively, or frequently about oneself and one's world"* (Segerstrom, Stanton, Alden, & Shortridge, 2003, p. 909). Repetitive negative thinking has also been identified as a transdiagnostic process (Ehring & Watkins, 2008), classified as taking various forms, including rumination, worry, cognitive and emotional processing, planning, problem solving and post-event rumination (Watkins, 2008). Associated with each form of repetitive thinking are features such as: the content of the thoughts (for example, worry involves fear of future events, outcomes and risk, whereas planning and problem solving involves consideration of coping strategies and mental rehearsal); a situational and/or intrapersonal context (for instance, being a mother at home); and each form tends to have an outcome which is positive (and adaptive), negative (and maladaptive), or in some cases the outcome can go either way. An example is repetitive thinking as cognitive and emotional processing, which, on the one-hand can lead to new insights, adjustment and positive growth, or, on the other-hand, increased and on-going distress, most likely influenced by the attributions an individual gives to the thoughts. In the context of clinically diagnosed insomnia, rumination has been found to be a distinct construct from worry, and rumination has been found to be independently associated with insomnia, after taking into account worry and dysphoria (Carney, Harris, Moss, & Edinger, 2010).

A mismatch between expectations and the realities of motherhood, including the physical, mental and emotional demands of caring for a newborn, changes to her own sleep, the sleep her infant 'should' be having, and conflict around roles (such as mother versus partner), tasks (paid work versus parenting work) and self (time for self, loss of confidence) have all been identified as common content in maternal thoughts (Barclay, Everitt, Rogan, Schmied, & Wyllie, 1997; Vik & Hafting, 2012). Self-efficacy relates to a mother's capacity to parent with a sense of competence and effectiveness (Teti & Gelfand, 1991). A mother may have knowledge of what is required, for instance she may recognise

her infant is tired and needs to settle for sleep, but she may feel distressed at leaving her baby alone to do this. Maternal low confidence and self-efficacy have been associated with both depression and infant sleep problems (Anders, Halpern, & Hua, 1992; Leahy-Warren, McCarthy, & Corcoran, 2012; Meijer & van den Wittenboer, 2007).

Emotions

Women express a full range of emotions around childbirth and early parenting, from joy and elation to anxiety, sadness and terror (Beck, 2006). Non-depressed and depressed women may experience ambivalence, for instance feeling both joy and sadness about motherhood, but it is the frequency, intensity and duration of these feelings that will define her mood as depressed or not. Guilt and loss are also common amongst women with postnatal depression (Mauthner, 1999; Vik & Hafting, 2012).

An old adage suggests that if an individual is feeling troubled by a problem they should "sleep on it" and they will feel better in the morning. Sleep, and in particular, REM sleep, has been shown to have a role in processing the emotional content of memories (Groch, Wilhelm, Diekelmann, & Born, 2013) so that distilled content or the gist of the memory is preserved, but the affect associated with the memory diminishes (Payne & Kensinger, 2010). It is hypothesised that this mechanism is disrupted in individuals affected by post-traumatic stress disorder who are subjected to reliving traumatic experiences over and over in vivid dreams and flashbacks (Germain, 2013).

Duration of waking also appears to influence affect processing. Participants who completed an emotional face recognition task at midday, after their usual nocturnal sleep, were assigned to either a 90-minute mid-afternoon nap or no-nap condition, and then completed the recognition task again at 5 p.m. Emotional reactivity to anger and fear expressions increased across the day in the no-nap condition and positive affect declined. Those in the nap condition had a reduction in ratings of expressions anger and fear, an increase in ratings of the happy expressions and no change in ratings of sad expressions. Concomitantly, participants experienced an increase in positive affect after the nap. The nap group was further split into those who experienced REM sleep and those who did not, during the nap period. Experiencing REM sleep was most significantly associated with a reduction in fear reactivity and an enhancement of positive reactivity and affect, and these two effects were only observed in the REM nappers (Gujar, McDonald, Nishida, & Walker, 2011).

Not only does sleep appear to influence affect, but a heightened emotional state is theorised to mediate the interaction of cognitions and autonomic processes associated with insomnia (Espie, 2002). Worrying, or feeling sad, angry or guilty may collude with a

heightened physiologic state to make sleep onset or maintenance difficult. Further, the timing and duration of sleep can influence the opportunity to achieve REM sleep and therefore capitalise on the emotional regulation associated with this stage of sleep neurophysiology (Gujar et al., 2011).

Environment

The wider context in which the woman and her infant are living can impact sleep, as shown in Figure 2, the transactional model, shown on page 30. The environment includes geographic environment, which may be rural or urban, isolated or built-up, and subject to forces of nature such as earthquakes or storms. At a more proximal level, the family's physical sleep environment can affect sleep including who sleeps with whom and where, particularly the location of the infant for night sleep, and other sensory factors like noise, light, temperature and comfort in the bedroom or sleep location.

Sleep hygiene (Hauri, 1991) practices are designed to promote sleep and include such measures as ensuring bedding is warm and comfortable, noise is reduced to the lowest possible levels and light is eliminated. Application of these principles has been found to improve sleep in a wide range of populations (for a review see Stepanksi & Wyatt, 2003) including young mothers with low levels of socioeconomic resources (Lee & Gay, 2011).

Sleep and mood postpartum

Sleep disturbance is associated with deficits in short term memory, reaction time, motor skills, mood and decision making, all of which are critical for new mothers who are either learning the skills of parenting as a novice, or meeting the demands of an expanded family (Durmer & Dinges, 2005; Harrison & Horne, 2000).

Reducing sleep duration by three hours for just one night in a controlled environment produces a statistically significant increase in depressive symptoms (Valck & Cluydts, 2001) and poor sleep quality appears to be predictive of a reduction in positive affect (described by terms such as feeling confident, energetic and happy) in both healthy adults and those meeting diagnostic criteria for a mood disorder (Bower, Bylsma, Morris, & Rottenberg, 2010). All new mothers are therefore potentially at risk of negative mood changes from sleep disruption in the postpartum, and those with an existing mood disorder (whether diagnosed or not) may be even more vulnerable at this time.

While these sleep disturbances are transient for many women, reducing over time as their infants require less intervention at night, for some women night waking becomes associated with increased cognitive arousal and they develop chronic insomnia. Being a

woman predicts the risk of developing insomnia (Roth, Roehrs, & Pies, 2007), and for women with a predisposition to sleep difficulty, pregnancy and childbirth may become precipitating and perpetuating factors for this ongoing inability to fall asleep or stay asleep (Espie, 2007).

A prospective study of 505 women with EPDS scores greater than 13 at one week postpartum were surveyed again at four and eight weeks postpartum and found that shortened sleep duration (less than 6 hours), infant sleep patterns (waking three or more times between 10 p.m. and 6 a.m.) and subjective ratings of maternal fatigue were strongly associated with new onset of postnatal depressive symptoms (Dennis & Ross, 2005).

Poor sleep quality and sleep disturbance have been found to be independently associated with depression, after adjusting for recognised risk factors of postpartum depression including poor partner relationship, previous depression, depression during pregnancy, and stressful life events (Dorheim, Bondevik, Eberhard-Gran, & Bjorvatn, 2009a). In their population-based survey study of 2,830 postnatal women, Dorheim et al. (2009a) found that two months after birth, nearly 60% of the postpartum women experienced poor global sleep quality as measured using the Pittsburgh Sleep Quality Index, and 16.5% had depressive symptoms (scores equal to or greater than 10 on the EPDS).

Measuring postpartum mood

A wide range of methods and instruments exist to screen for and diagnose depression in the general population. Clinical interviews are regarded as the "gold standard" for diagnosis of mood disorders or for validation of self-report measures. By virtue of being a 'clinical' interview, this method of diagnosing mood disorders is only available to suitably qualified (or supervised) health professionals. In order to provide diagnostic accuracy, clinical interviews are necessarily time consuming, which may increase burden on the individual. These two factors combine to make for a costly method of measurement which may be considered in both financial terms and in terms of potential burden on the individual. Individuals might also choose not to disclose depressive symptoms for fear of being judged in some way, such as being seen to be a poor mother (Hall, 2006). Further, postpartum women are usually involved in their infants care around the clock, which may make it difficult to attend appointments or even keep appointments scheduled in the home.

A number of tools are commonly reported for identifying postpartum depression including the Beck Depression Inventory-II (Beck, Steer, & Brown, 1996), the General Health Questionnaire (Goldberg et al., 1997) and the Hospital Anxiety and Depression

Scale (Zigmond & Snaith, 1983). However, during the late 1980's, it was increasingly recognised that general population measures of depression may not be suitable for postpartum women and this lead to the development of the EPDS (Cox et al., 1987). Cox et al. developed this self-report scale to address the limitations they identified in previously established depression scales. These limitations included a potential over-emphasis on somatic symptoms (such as weight loss or feelings of fatigue) which are likely to be associated with normal physiologic changes and demands around childbirth, as well as a reluctance to use previously established instruments by community health workers because of time pressures and the potential low face validity of other instruments in this population. The EPDS is now one of the most widely used self-report instruments used to screen for symptoms of mental health difficulties (depression and anxiety) in the perinatal period. The EPDS has been translated for use in more than 20 languages and has been validated for use across many more cultures (Gibson, McKenzie-McHarg, Shakespeare, Price, & Gray, 2009), as well as for use with fathers (Matthey, Barnett, Kavanagh, & Howie, 2001). The EPDS has also been validated for use in the prenatal period (Murray & Cox, 1990).

It has also been suggested that, in order to capture a more accurate representation of disturbance to postpartum mood, the term 'postpartum distress' be applied, encompassing not only depression, but anxiety and stress (Miller, Pallant, & Negri, 2006). The EPDS captures the depression and anxiety dimensions of postpartum distress.

Risk factors for postpartum depression

The reported range of possible risk factors for postpartum depression is wide and includes the biological and psycho-social candidates previously described for depression in the non-perinatal population. Comparison of perinatal depression studies is hampered by a number of methodological issues including differences in the time-span of the period under review, the definition of criteria used and the methods used to assess it. O'Hara and Swain (1996) conducted the first substantial synthesis of literature using standardised meta-analytic techniques. Postnatal depression was most strongly predicted by having a prior history of psychopathology, depressed mood during pregnancy, low social support including low partner support, and stressful life events. Neuroticism, negative cognitive attributional style and obstetric variables (such as pregnancy or birth complications) had small but significant relationships with postpartum depression. Only weak or no relationships were found between postpartum depression and maternal age, occupation, marital status, duration of partner relationship, education, number of children, parity, and employment status.

Beck (1996a) published a first meta-analysis of studies focused on predictors of postpartum depression. Prenatal depression was the strongest predictor in her review, followed by childcare and life stresses, social support, prenatal anxiety, baby blues and marital satisfaction. History of previous depression was demonstrated to have a small relationship with postpartum depression, and in the same year but in a different analysis, infant temperament was also shown to have a significant predictive relationship with postpartum depression (Beck, 1996b). In Beck's (2001) updated meta-analysis of 84 studies, where depressive symptoms were measured through self-report and/or clinical interview, four new risk factors were identified. The 10 strongest of these were prenatal depression, self-esteem, childcare stress, prenatal anxiety, life stress, social support, marital relationship, history of previous depression, infant temperament, and experiencing the baby blues. Marital status, socioeconomic status, and unplanned/unwanted pregnancy were significant in predicting postpartum depression but with only a weak effect.

Most recently, Robertson et al. (2004) conducted a meta-analysis, taking into account these previous analyses, plus studies involving an additional 10,000 participants, making a total of over 24,000 subjects . This substantial analysis confirmed five factors as having the strongest relationship with postpartum depression: depression during pregnancy, anxiety during pregnancy, stressful life events during the perinatal period, low levels of social support, and a prior history of depression. Significant, but with small effect sizes associated neuroticism, marital relationship (reflected as feeling isolated or lacking in social support), socioeconomic status and obstetric factors with postpartum depression.

Finally, data from 12,361 Australian women, who were screened during pregnancy and at 6 weeks postpartum using the EPDS, was analysed using multiple logistic regression (Milgrom et al., 2008). Findings included that the strongest risk factors for elevated scores on the EPDS at 6 weeks postpartum (greater than 12) were: antenatal depression, antenatal anxiety, major stressful life events, low practical or emotional support, low partner support and previous history of depression—all factors identified in previous meta-analyses. The personality factor of maternal perfectionism also independently predicted elevated depressive symptoms in the postpartum in this cohort.

Social support is seen as one of a number of recognised social determinants of health (Locker, 2008). Social support can be understood as having a structural dimension—the number and type social networks into which a person feels they fit—and a functional dimension—the specific functions a relationship provides, such as help with tasks or a listening ear (Uchino, 2006). Low levels of social support have been associated with heart disease, (Uchino, 2006), adverse pregnancy outcomes (Collins, Dunkel-Schetter,

Lobel, & Scrimshaw, 1993) and postnatal depression (Leahy-Warren et al., 2012). A particularly important structural relationship for pregnant and postpartum women is that with their intimate partner, if they have one (Montgomery, Bailey, Purdon, Snelling, & Kauppi, 2009).

Experiencing stressful life events has previously been identified as a core risk factor for postnatal depression. An Australian study involving over 12,000 women found that women who scored highly on a measure of stressful life events in the previous year were 2.5 times more likely to have elevated postnatal depression scores at six weeks postpartum (Milgrom et al., 2008). In a separate study of 2,430 Swedish women, Rubertsson et al. (2005) found a dose-response relationship between prenatal stressful life events and postnatal depression such that postnatal depression was, in part, predicted by experiencing two or more stressful life events in the year leading up to pregnancy.

Consequences of postnatal depression

With a birth rate of over 61,000 per year and applying estimates of the prevalence of postnatal depression of 13% to 20%, between 7,900 and 12,200 New Zealand families are likely to be impacted each year by this condition. Further, the consequences of postnatal depression can be varied and far reaching, meaning the deleterious effects of an incident episode of postnatal depression are not necessarily confined to that period of illness, nor to just the mother.

Maternal-infant interactions can be disrupted by postnatal depression and women can become withdrawn from their infants, missing important cues the baby is giving in order to practise communication and have its needs met (Murray, Cooper, & Hipwell, 2003). Conversely, some depressed women become more hostile and intrusive with their infants, also failing to recognise distress cues, but in this situation, continuing with rough or otherwise insensitive mother-infant interactions. In turn, these factors have been associated with attachment insecurity, poorer cognitive development and longer term behavioural difficulties in childhood (Murray et al., 2003).

Close maternal-infant interactions are implicated in the development of emotional regulation in both infants and their mothers, as well as laying the foundations for infant communication skills (Tronick, Als, & Brazelton, 1977). When these interactions are reciprocal, harmonious and adaptive they are said to be synchronous (Reyna & Pickler, 2009) and this process of affective and attentional attunement is regarded as fundamental to the attachment process (Field, Healy, Goldstein, & Guthertz, 1990). When this synchrony occurs, a process of positive feedback evolves which builds confidence and self-efficacy in the woman, particularly in regard to her role as a mother (Logsdon, Wisner, &

Pinto-Foltz, 2006). Depressed mothers are less likely to engage in synchronous behaviours leaving them with fewer strategies to regulate their own and their infant's affective state (Feldman, 2003).

Mothers who experience postnatal depression are less likely to breastfeed their infants (Henderson, Evans, Straton, Priest, & Hagan, 2003; Piteo, Yelland, & Makrides, 2012). When this happens, not only do the mother and infant miss out on the immediate and long-term benefits of breastfeeding (see Allan & Hector, 2005, for a useful summary), but opportunities for close maternal-infant interaction may be reduced. The hormone oxytocin is released during breastfeeding and has a role in the physiologic release of breastmilk (through the milk ejection reflex) as well as activating the parasympathetic nervous system (thereby decreasing stress) and promoting pro-social, nurturing behaviours in the mother (Uvnäs-Moberg, 1998), all of which may be protection against depression (Apter-Levy, Feldman, Vakart, Ebstein, & Feldman, 2013). Of course, breastfeeding provides just one opportunity for synchronous interactions, and women who are not able to breastfeed can engage equally closely and adaptively with their infant during feeding and all other interactions, as can fathers (Feldman, 2003).

Women who experience postnatal depression are at increased risk of recurrent episodes of depressive disorder, and may be twice as likely to experience further episodes of depression during a five-year period after the initial postpartum episode (Cooper & Murray, 1995). In a longitudinal prospective study conducted over 13 years, mothers who became depressed in the postnatal period were likely to have recurrent episodes of depression throughout the course of the study. When this was the case, elevated rates of depression were seen in the adolescent children in the study who had been exposed to maternal postnatal depression with subsequent recurrent episodes (Halligan, Murray, Martins, & Cooper, 2007).

As well as the distress experienced by the mother, and the potential consequences for the mother-infant relationship and on-going development of the infant, postnatal depression is also associated with marital/partner relationship discord (Burke, 2003).

Most mothers with postnatal depression do not harm themselves or their babies. However, in a rare few cases, maternal suicide, child abuse and/or infanticide may occur as a result of severe mood disturbance (Marks, 2009; Sit et al., 2006).

It should be acknowledged that not all women who experience postnatal depression behave in the ways described here, or have further episodes of depression, nor do all children of women who have had postnatal depression go on to have adverse outcomes (Piteo et al., 2012; Wan & Green, 2009).

Interventions

In becoming a parent, mothers and fathers step onto a metaphorical life-long 'travelator' which takes them past a non-stop array of choices related to their family and parenting style—home birth or hospital? Midwife or specialist obstetrician care? Pharmacological pain relief in labour or not? Breastfeed or formula? Baby in the parental bed/room for sleep or not? Immunise? Leave to cry or pick up at the first whimper? Get a routine going straight away or go with the flow? Parenting is as varied as the individuals involved in the family and because of this, it would be presumptuous to assume that all parents want or need what may be perceived as expert advice when it comes to their infant's sleep. However, at least 30% of New Zealand parents report their infant or toddler's sleep to be a problem (Mindell et al., 2010). Given the number of parents who report their child's sleep to be problematic, and the distress associated with poor sleep and poor maternal mood (separately and collectively), the provision of evidence-based information on infant and maternal sleep represents a cost-effective, low level intervention which has the potential to ameliorate some of this distress. Further, given the current cultural milieu, in which pressures exist for parents to return to work within a few months of birth, and culturally prevalent expectations around infant sleep that are focused on early childhood independence and a minimum of disruption during the night, such intervention may help parents balance the tensions between what they want and what they need to achieve in their unique family life balance. Finally, in viewing sleep as a transdiagnostic mechanism in a range of disorders including perinatal distress, the benefit of evidence-based interventions may extend beyond just the mother who is in search of a good night's slumber.

What then can be done to optimise sleep during this important life stage? Given that the main factors identified as contributing to sleep disturbance in the early postpartum are related to essential infant care, strategies to improve sleep may be limited in number. That said, an American Academy of Sleep Medicine review of behavioural approaches to sleep problems in infant and children (Mindell et al., 2006) led to the publication of practice parameters on the same topic (Morgenthaler et al., 2006). Standardised rules of evidence were used to rate the study design in the publications under review. Parent education, particularly in the prenatal period or early infancy, was recommended for adoption as standard practice based on evidence for efficacy having met the highest level of critique. It was noted that further research was still required to determine the most effective way to deliver such education.

Behavioural interventions targeted at improving infant sleep have also had positive results in a number of studies. A longitudinal, cluster-randomised controlled trial was

carried out by Hiscock et al. (2008) with 328 mothers who reported their infant's sleep to be a problem at seven months of age. The intervention strategy was to instruct parents to use their choice of either graduated extinction, described as 'controlled crying', where parents respond to infant crying at bedtime at intervals which increase by two minutes each time, up to 10 minutes, or adult fading, described as 'camping out', where parents sit in the room with the child until sleep onset, gradually withdrawing their presence from the bedroom over two to three weeks. Mothers chose the strategy that was most acceptable to them. Mothers were followed up when the children were 10 months, 12 months and two years of age. Mothers in the intervention group were less likely to report depression than control group mothers, less likely to report that their child's sleep was a problem and less likely to have sought professional help for infant sleep issues. While the results of this study are promising and acknowledge flexibility and choice for parents, interventions using extinction techniques are not recommended for children before the age of six months (Douglas & Hill, 2013; Galland & Mitchell, 2010).

Most studies have intervened once the infant is born, and often after six months and/or once problems have arisen (for example Hiscock & Wake, 2002; Mindell et al., 2009). Two studies offered information and strategies to parents in the last trimester of pregnancy, with follow-up information and/or contact in the first two to four months postpartum (Pinilla & Birch, 1993; Wolfson, Lacks, & Futterman, 1992). In both studies, parents were instructed to offer their infant a 'focal feed' (also known as a 'dream feed') between 10 p.m. and 12 a.m. at night, which means rousing the infant to offer a feed if they are asleep at that time. The goal of such feeds is to meet the infant's nutritional requirements and reduce the number of awakenings between midnight and early morning without compromising breastfeeding viability. Parents were also instructed to delay their response time to their infant at night, particularly if their infant's vocalising was considered to be complaining or grizzling rather than crying, and both of these strategies were aimed at increasing the duration of the infant's longest sleep period at night. Pinilla et al. (1993) reported that all infants in the intervention group (n = 12) were sleeping through the night by eight weeks of age where 'sleeping through the night' was defined as not waking between 12 a.m. and 5 a.m. Wolfson et al. (1992) reported that at 6–9 weeks of age, intervention group infants woke less frequently during the night and were more likely to sleep for periods of at least 300 minutes during the night time (another definition of sleeping through the night). Parents in the intervention group also reported higher parenting competence and less stress.

Two studies have found that breastfeeding mothers obtain more sleep than their bottle-feeding peers, especially when they co-sleep with their infant (Doan, Gardiner, Gay,

& Lee, 2007; Quillin & Glenn, 2004), and a further study found that breastfeeding and bottle-feeding mothers obtained similar amounts of sleep but that sleep architecture differed between groups (Blyton, Sullivan, & Edwards, 2002). Breastfeeding mothers obtained more restorative slow-wave sleep. Both groups were awake for similar durations so the extra slow-wave sleep was not considered a homeostatic mechanism (where the drive to obtain sleep is influencing sleep architecture), rather it was hypothesised to be a benefit of extra circulating prolactin in the breastfeeding mothers. Encouragement of breastfeeding is worthy for many health-related reasons (American Academy of Pediatrics, 2012) and perhaps the sleep-promoting benefits of lactation should also be emphasised to expectant and new parents.

Few studies have attempted to address both infant and maternal sleep. The Tips for Parents and Infant Sleep or TIPS study (Stremler et al., 2006) was a randomised controlled pilot study of a behavioural-educational intervention involving 30 first-time mothers. Intervention group mothers received education and sleep tips at the postnatal hospital bedside, followed by supportive phone calls for five weeks after discharge. The sleep of mothers and infants was monitored using actigraphy at six weeks postpartum and mothers completed sleep diaries. Intervention group mothers obtained 57 minutes more sleep at night on average and were less likely to rate their sleep as a problem, compared to control group mothers. Intervention group infants had, on average, fewer nighttime awakenings and longer maximum sleep periods (46 minutes) than control group infants.

Developing an intervention

New parents are offered little in the way of preparation for postnatal sleep and it has been noted as a deficit in current childbirth and parenting preparation classes (Dwyer, 2009) and, as previously discussed, sleep may act as a transdiagnostic mechanism in a range of poor maternal outcomes including postnatal distress. Further, some aspects of parental bedtime interactions with their infants appear to be related to sleep problems (Adair, Bauchner, Philipp, Levenson, & Zuckerman, 1991) and in some families these sleep problems persist through later childhood (Wake et al., 2006). Parents may unwittingly contribute to these problems early in their infant's life. A behavioural-educational sleep intervention (The PIPIS Programme) was therefore designed, as part of the present study, to provide first-time mothers (and their families) with evidence-based information and sleep promoting strategies related to their own sleep and their infant's sleep in the first three months postpartum.

The TIPS programme (Stremler et al., 2006), described previously, gave the impetus to develop and trial a similar programme with New Zealand mothers. The TIPS

programme was offered at the bedside to mothers in the postnatal wards of university teaching hospitals. This was not feasible in the New Zealand setting, where postnatal stays can be as short as two-hours and are commonly under 48 hours (Vance, 2013). In current postnatal ward regimens such an intervention is unlikely to be accommodated. The model of midwifery care in New Zealand is such that many women receive their perinatal care from an independent, case-loading, community based midwife. Postnatal midwives are often under time duress to carry out essential maternal and infant assessments, as well as assisting mothers with breastfeeding and other infant cares. It was decided that the logistics of presenting a two-hour education programme to women, either one-on-one or in a group setting, would not likely be accommodated in postnatal care as it currently exists. Independent midwives are unlikely to be in a position to offer an individualised education session in the very early postpartum because of the demands of their case-load, although they may be in a position to offer the follow-up support component of an intervention.

A number of organisations exist that may be able to offer a programme with a prenatal education component and a postnatal support component, including the Royal New Zealand Plunket Society and Parents Centres New Zealand, who both have existing frameworks for educating and supporting parents. A number of Primary Health Organisations also offer pre and postnatal health services, education and support, and these include providers who specifically offer services for Māori or Pasifika people. Therefore, the PIPIS Program education session was developed to be offered as a one-off prenatal class—similar in duration and style to a typical childbirth education class, with the added component of follow-up telephone support.

The course content was informed, in part, by the transactional model of sleep (Sadeh & Anders, 1993; Sadeh et al., 2010) previously described on page 29. Emphasis was placed on the uniqueness of each mother and each infant's sleep patterns and habits and the bidirectional relationships between mother, infant and environment. The model illustrated on page 30 was adapted and redrawn (see Figure 4) to simplify both the language and the flow of the systems involved. This was intended to make the concepts in the model more accessible to expectant parents attending an evening education class in the last trimester of pregnancy. Sleep of the infant was made central but the model still depicted the complexity of mostly bidirectional links. This was then used to discuss how sleep is a dynamic human function, which changes across the lifespan as a result of intrinsic and extrinsic influences, with the greatest changes occurring in infancy. The model was also used in an explanation of the points at which parents might intervene or

interact with their infant's sleep in ways that may help or hinder sleep development in both the short-term and long-term.

Figure 4. Modified transactional model of sleep development as used in PIPIS education session. (Original sources Sadeh & Anders, 1993 and Sadeh, Tikotzky & Scher, 2010).

The provision of evidence based sleep information and norms was intended to build maternal confidence and foster realistic expectations about maternal and infant sleep in the early postpartum. The main topics covered in the two-hour education session are shown in Table 1. Importantly, parents were not instructed to leave their infant to cry themselves to sleep, and they were encouraged to feed, cuddle and rock their infant as they saw fit, especially during the early weeks of transition from 'womb to world'. This was described as the 'arrival and survival' stage during which the infant arrives into the ex-utero world, and the parents do whatever it takes to cope and survive during this period of intense adjustment. In her work on the transition to motherhood, Mercer (2004) describes this stage of becoming a mother as the stage of acquaintance, learning and physical restoration, occurring over the first 2–6 weeks postpartum. During this stage, parents were also encouraged to start to look for opportunities to allow their infant to fall asleep with minimal assistance from others (such as being fed or rocked to sleep) as and when they felt comfortable. It was explained that infant self-regulation developed over time, as a natural progression towards sleeping through the night at some point in the future and that this which would vary from family to family.

Table 1
Main topics in PIPIS education session and booklet

Topic	Included in content
General sleep	Basic science of adult human sleep and possible consequences of insufficient sleep (in adults).
Sleep for mothers	Changes to sleep during pregnancy and postpartum and the possible consequences of such changes.
Sleep for infants	Sleep development in the newborn, normative data about infant sleep and the uniqueness of each infant's sleep.
Infant sleep safety	Guidelines from the Ministry of Health (2013) and Change for our Children (www.changeforourchildren.co.nz).
Promoting maternal sleep	Healthy sleep guidelines (sleep hygiene), time management, relaxation and cognitive strategies for managing stress. Prioritising sleep opportunities, especially in the early weeks after birth, was emphasised.
Promoting infant sleep	Emphasis on the importance of establishing feeding, understanding infant sleep cycles, learning to observe the infant for cues, understanding tired signs, creating a simple bed-time routine, coping with crying, and settling strategies—within the context of the infant's unique environment and developmental pathway.

Research indicates that there are sensitive periods for developmental transitions to occur. For instance, infant weaning from milk to solid food is a developmentally programmed process which involves loss of the neonatal gag reflex, gastric maturation and readiness to chew and swallow food (Koplin & Allen, 2013). Infants usually reach readiness to begin to wean when they are between six to seven months of age, after which there is a three to four month window of opportunity to initiate the transition. Infants who have not been introduced to foods of differing textures by ten months of age have been shown to have more feeding problems at 15 months of age than those who were exposed to lumpier foods at ten months (Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011).

Infant sleep also progresses in a developmentally programmed way (Anders & Keener, 1985; McGraw et al., 1999; Sadeh, Raviv, & Gruber, 2000) except that the development of biological sleep-wake mechanisms may be even more inextricably linked with the infant's environmental or biopsychosocial context (Jenni & Carskadon, 2007; Sadeh & Anders, 1993). Two of the key processes involved in infant sleep state maturation (regulation and consolidation) were highlighted in the education session. Regulation has been defined as "the ability of infants to transition smoothly from wakefulness to sleep" (Sadeh & Anders, 1993, p. 18) and sleep consolidation has been defined as "the infant's ability to sustain sleep in a continuous fashion for an age-appropriate period of time

before fully awakening" (Sadeh & Anders, 1993, p. 18). Sadeh et al. (1993) noted "It is still not clear what infants should be doing and when, and what is the normal range of individual variation." Teasing out what constitutes an infant sleep problem and what constitutes a normal variation of infant sleep development was a challenge twenty years ago and continues to vex clinicians and researchers today (Owens & Mindell, 2006). There is certainly more empirical data available now regarding the normative infant sleep patterns and parental behaviours associated with infant sleep (Middlemiss, 2004; Sadeh et al., 2010); however, midwives, general medical practitioners, childbirth educators and Well-Child nurses anecdotally report that giving parents the precise, concise and prescriptive advice they are often seeking is a challenge. This has been summarised elsewhere as "There is little consensus, however, regarding which sleep behaviors should be considered as typical developmental changes and which sleep patterns are within a normal range for a particular age" (Jenni & Carskadon, 2007). This is not to suggest a complete void exists, rather that the picture is not yet complete and is likely to be complex.

Past studies have suggested that infants who require externally mediated soothing to fall asleep may have more difficulties in developing the capacity to resettle themselves after spontaneous awakenings at night (Adair et al., 1991; Keener et al., 1988), and when this is the case, these difficulties can extend beyond infancy (Zuckerman, Stevenson, & Bailey, 1987). Parents also change their perception of their infant's sleep as a problem over time, fluctuating between sleep as a problem or not (Wake et al., 2006), which most likely reflects not only the variability in infant sleep behaviour and development, but also the variability in parental levels of stress and coping at any one point in time. In light of this, parents were encouraged to observe and follow their infant's cues and use any strategies they preferred to promote attachment with, and settling of, their infants for sleep during the first two to three months after birth. This was described as the 'growing and knowing' stage. Mercer (2004, p. 231) refers to this stage in the process of becoming a mother "as moving toward a new normal" over the course of the first two weeks to four months. At the same time they were also encouraged to be alert for opportunities to allow a natural process of learning to self-regulate to unfold, and to increase this vigilance from about three months after birth. This period was described as the "shaping and settling" stage. This was summarised for participants in Figure 5.

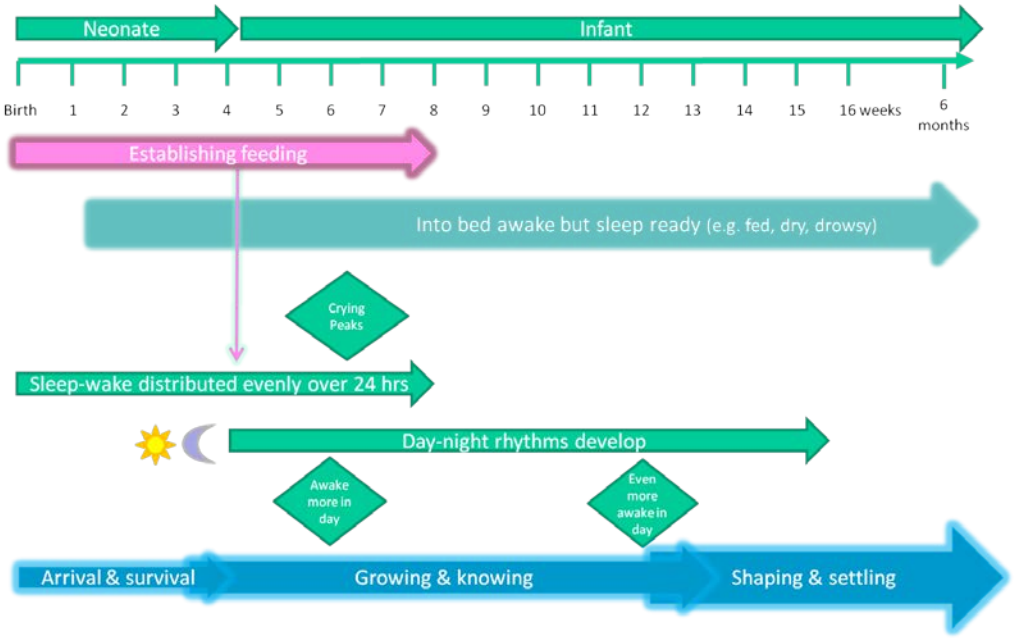

Figure 5. A generalised guide to infant sleep development.

Another feature of the PIPIS approach was the recognition that parents are the best judges of their own needs and readiness to shape infant behaviour such as through delaying response times to an infant who signals to them during the night. It was proposed to participants that a broad goal expressed by many parents is to have their infant sleeping through the night as soon as possible. This process may be facilitated by capitalising on opportunities for the infant to fall asleep or go back to sleep with minimal extrinsic intervention. As time goes by, parents often find they become more determined in their efforts to tip the scales in favour of the infant regulating these processes, as shown in Figure 6. The diagram has no units on the time scale as when this shift happens is a matter of individual need, readiness and choice, however, information about sensitive periods was designed to help parents understand their role in facilitating self-regulation.

The bi-directionality of infant-parent sleep interactions was also discussed. Parents' interactions with their infants when settling or resettling them for sleep can be motivated by parental beliefs, expectations and cognitions about sleep. Equally, they may be influenced by such factors as the temperament, health and behaviours of their infant (Sadeh et al., 2010). The influence and interactions that one then has with the other becomes a continuous and dynamic process, akin to a dance. Parents and infants may alternate in taking the lead whilst simultaneously observing and adjusting to change.

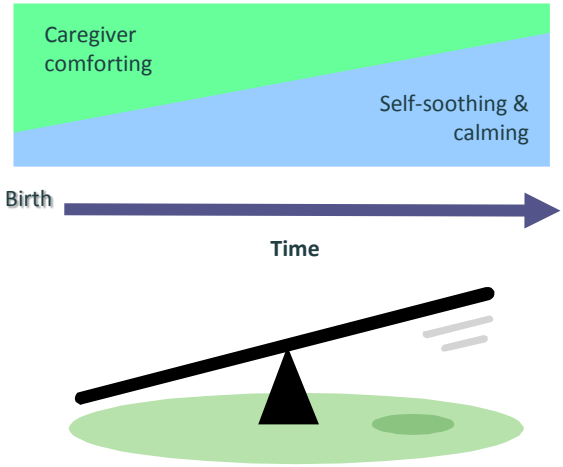

Figure 6. Graphic of a hypothetical scale used to describe the balance between extrinsic or parent-led infant comforting and intrinsic or infant-led regulation for sleep.

Intervention group participants received a 67-page colour PIPIS booklet which contained all of the information covered in the two-hour session as well as details of further resources and links to extra parenting information.

The intervention phase of the study lasted until six weeks postpartum. During this time, intervention group mothers received regular telephone calls aimed to give support and an opportunity to ask questions about infant sleep. Participants were also reminded to use the resources received at the education session, such as the PIPIS booklet and relaxation audio recording.

Summary

Obtaining sleep of sufficient duration and quality is essential to healthy human functioning. Typically, seven to eight hours of sleep, with few interruptions, are considered enough to meet the requirements of most people. However, during pregnancy and in the months after childbirth sleep disturbance is common. In non-pregnant populations, insufficient sleep quantity and quality have been linked to negative changes in neurocognitive and behavioural performance in the short term, and poor health outcomes, such changes to metabolism, in the longer term. Insufficient sleep quantity and quality are also associated with depression and it has been proposed that sleep may be a transdiagnostic mechanism that is common to a range of disorders including depression, insomnia and inappropriate inflammatory responses.

At the same time, pregnant and postpartum women may be at increased risk of developing mood disorders. Increasing our understanding of what normal sleep is during

the perinatal period is the first step in understanding potential links between altered sleep and altered mood at this time. To date, there have been no large scale studies of the sleep of women during late pregnancy or the first three months postpartum in New Zealand.

There is currently also a dearth of evidence based sleep information for expectant parents and parents in the first weeks of life with a newborn infant. Midwives, Well-child nurses and general practitioners anecdotally report that infant sleep is one of, if not, the most frequently raised concerns for new parents. Early education of parents may influence not only maternal and infant sleep quality and quantity, but also maternal self-confidence to manage sleep changes at this pivotal stage of family life. In turn, equipping new mothers with realistic expectations about perinatal sleep, increased self-efficacy and a range of strategies to help optimise sleep may positively impact postnatal mood.

Study background and aims

The present study is the culmination of a programme of research which began in 2007. In that year, a feasibility study was conducted by the Sleep/Wake Research Centre to develop and trial questionnaires for a large-scale, longitudinal study[4]. Two comprehensive questionnaires were developed during the feasibility study – the Sleep and Health during Pregnancy Questionnaire and the Postpartum Sleep and Health Questionnaire. Protocols for a postnatal telephone survey were also developed. At that time, 32 two women completed all three surveys and a further 22 women completed the postnatal survey only. Focus groups were conducted to elicit feedback from a subset of participants. Women reported that they were highly supportive of the study's aim, they found the questionnaires straight-forward to complete, and they did not find participation onerous, despite being pregnant or caring for a newborn.

In 2009, funding was secured by the Sleep/Wake Research Centre to conduct a three year project investigating links between perinatal sleep and maternal health. An expert reference panel was established to give input into the development of the final measures and processes for the E Moe, Māmā, Sleep and Maternal Health in Aotearoa/New Zealand study. This group comprised an obstetrician, midwives, a paediatrician (with infant sleep expertise), a psychiatrist (maternal mental health), perinatal distress counsellor, Māori health researchers, and a bio-statistician/epidemiologist. This main project had three main aims, which have been named as three studies: 1) *E Moe, Māmā: Hapu Ora* aimed to investigate the relationship between prenatal sleep and birth experience, based on evidence that poor sleep during pregnancy is associated with longer labour duration and higher rates of medical intervention (Lee & Gay, 2004); 2) *E Moe, Māmā: Hauora Hinengaro* aimed to investigate the relationship between perinatal sleep and maternal mood at 3 months postpartum; and 3) the *PIPIS Project* aimed to trial a behavioural-educational sleep intervention for first-time mothers. Aims 2 and 3 are the subject of this thesis.

To facilitate aims 1 and 2, a large scale, short-term longitudinal survey study of self-selected participants was conducted—the E Moe, Māmā Maternal Sleep and Health in Aotearoa/New Zealand study (or the E Moe, Māmā study for short). Data from the 951 women (316 Māori) who completed the final stage of this study, within the originally specified timeframe, has been analysed and presented here as Study One–E Moe, Māmā: Hauora Hinengaro.

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[4] I was involved in all aspects of the feasibility study and data from the study was used to complete my honours dissertation.

The objectives of Study One were:

1. To measure the change in sleep and mood across the perinatal period in New Zealand women. It was hypothesised that:
    - Compared to usual self-reported sleep prior to pregnancy, sleep duration and quality would decrease across pregnancy and be poorest in the first eight weeks postpartum.
    - Sleep duration and quality would then improve by 3 months postpartum.
    - Mood would also change from pregnancy to the postpartum period, and it was expected to be poorest at 3 months postpartum.
2. To report the prevalence, in a convenience sample of women, of perinatal distress (including stressful life events, worry, anxiety and postnatal depression) in the third trimester of pregnancy, in the first eight weeks postpartum and at three months postpartum. It was hypothesised that:
    - Symptoms of anxiety and depression were expected to be at the highest level at 3 months postpartum.
    - The prevalence of perinatal distress would be higher in Māori than non-Māori women.
3. To investigate the relationship of perinatal sleep with depressive symptoms at three months postpartum. Specific hypotheses relating to objective 3) were, that after controlling for demographic items and known risk factors for postnatal depression:
    - Women who report obtaining less perinatal sleep will report higher levels of depression at three months postpartum compared to women who obtain more sleep.
    - Women who report poor perinatal sleep quality will report higher levels of depression at three months postpartum compared to women who report less disturbed sleep.
    - Women who report greater change in perinatal sleep duration will report higher levels of depression at three months postpartum compared to women who report less change in sleep duration.
    - Women who report greater change in perinatal sleep quality will report higher levels of depression at three months postpartum compared to women who report less change in sleep quality.
    - Women who reported higher levels of perinatal snoring or restless legs syndrome would be more likely to report higher levels of depression at

three months postpartum compared to women who report less snoring or restless legs syndrome.

A separate study was designed and conducted to facilitate aim 3. The Parent Information on Parent and Infant Sleep (PIPIS) project involved 40 first-time mothers who completed all of the surveys used in the E Moe, Māmā study as well as additional questionnaires relating specifically to the PIPIS study. All mother-infant pairs in the PIPIS study also completed 48-hours of home based sleep/wake monitoring using actigraphy, at 6 weeks and 12 weeks postpartum. Methods, analyses and results are presented here as Study Two–The PIPIS Study.

The PIPIS study was designed as a pilot of a behavioural-educational sleep intervention. The primary, overarching research question for the study was: *does completion of an antenatal sleep education programme, with follow-up postnatal support, improve sleep in new mothers and their infants during the first 12-weeks postpartum?* Two secondary questions were predicated on the possibility of next steps for this work being a) replication of the study with a larger, sample and b) adaptation of the PIPIS programme for use in a wide range of community settings (for instance with teen mothers and among women of different cultures, particularly Māori mothers in Aotearoa/New Zealand). The secondary questions for the present study, therefore, were: *how acceptable to peripartum women were the tasks and processes of this behavioural-educational trial*, and, *how acceptable and useful did first-time mothers find the PIPIS programme in relation to their own, and their infants sleep, in the first three months postpartum?*

Five main hypotheses were tested in relation to the primary study question:

1. Mothers in the sleep intervention group will obtain more sleep in a 24-hour period, at 6-weeks and 12-weeks postpartum, compared to mothers in the control group.
2. Mothers in the sleep intervention group will report better sleep quality and fewer sleep problems, at 6-weeks and 12-weeks postpartum, when compared to mothers in the control group.
3. Mothers in the sleep intervention group will report higher levels of confidence about managing their infant's sleep at 12-week postpartum, compared to mothers in the control group.
4. Infants in the sleep intervention group will have fewer night time awakenings at 6-weeks and 12-weeks postpartum.
5. Infants in the sleep intervention group will have longer maximum night time rest periods at 6-weeks and 12-weeks postpartum.

Chapter Two

Study One–E Moe, Māmā: Hauora Hinengaro

Methods

Design

The E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand study was a community based, large scale, longitudinal, survey study in which participants completed two postal surveys and a brief telephone interview, all in their own homes. From the data collected in that study, a sub-sample of participants was selected for inclusion in Study One, on the basis of having completed the final questionnaire within the specified time frame of 11–13 weeks postpartum.

Participants

Cohort sample

In order to include the most representative sample possible of self-selected, community based participants, inclusion and exclusion criteria were kept to a minimum. Participants were required to be: 16-years of age or older; carrying a single foetus (no multiple pregnancies); and able to complete questionnaires in English. Participants had the option of completing questionnaires with assistance from the research team, usually by telephone. Recruitment for the E Moe, Māmā: Maternal Sleep and Health in Aotearoa/ New Zealand study took place over two years, from October 2009 to September 2011. Figure 7 shows the flow of the total number of women who participated in the E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand study.

Total number of participants

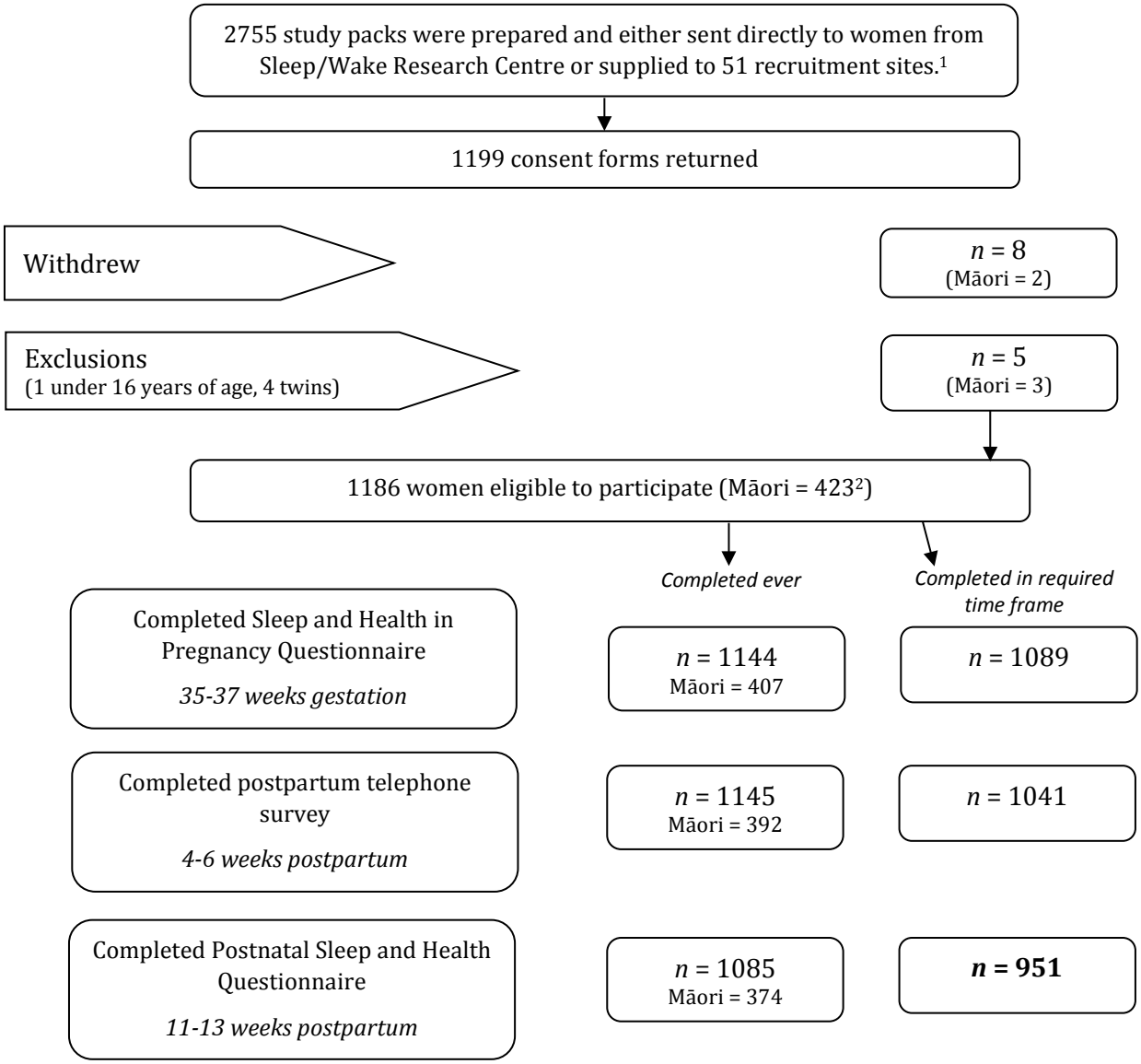

Figure 7. E Moe Māmā study response rates and participant numbers.

[1] Each recruitment site was given a set number of packs and a tracking sheet of matching pack numbers to record pack distribution to individual women. In the final analysis of response rates, actual number of packs supplied to individual women could not be determined as not all recruitment sites maintained or returned the tracking sheets.
[2] Actual figure may be higher. Ethnicity data was only collected in the study questionnaires and some women completed a consent form but did not go on to complete any questionnaires.

Study One sample

The sample used for analysis in the present study included only those participants from the main study who completed the 3 months postpartum questionnaire when their infants were between 11–13 weeks of age. As shown in Figure 7, this resulted in a Study One sample size of 951 women (Māori = 316, 33%), of whom 927 completed the Sleep and Health in Pregnancy Questionnaire (Māori = 300), and 925 completed the postpartum telephone survey (Māori 302).

Recruitment

Women were recruited into the study in a number of ways. A free "0800" telephone line, a study website, email address and free text messaging service were all established to allow women to make requests for information, a study pack, or to facilitate contact about any aspect of the study.

Midwives at publicly funded maternity facilities and in independent private practice were invited to assist with recruitment by introducing the study to women at a routine antenatal visit. Pre-prepared study information packs were supplied to midwives who then informed women of the study and gave them a pack to take away and consider. Midwives were encouraged to direct women to the telephone help-line if they had any questions about the study. A high level of support for the study, and enthusiasm to assist, was expressed at briefing meetings outlining the project and the process the midwives would be involved in. In practice, midwives found it difficult to incorporate an extra task into already full and time-stretched appointments.

A study recruitment poster and fliers were designed and distributed widely in the community including at libraries, public swimming complexes, baby ware shops, childbirth education classes, breastfeeding education classes, and medical centres. The posters and fliers were also placed at medical pathology clinics in all areas, as during pregnancy, women complete routine blood screening tests on a number of occasions.

The posters and fliers gave a brief outline of the study, requirements of participation and the compensation offered for survey completion (up to $40). Text messages in response to posters and fliers generated an automated reply and were subsequently followed up with a telephone call from a member of the research team. A study information pack was sent to all women expressing any interest in participation.

Initially, participants for the E Moe, Māmā: Maternal Sleep and Health in Aotearoa/ New Zealand study were recruited from within the Wellington, Hutt Valley, Hawkes Bay and Mid-Central District Health Board regions of the lower North Island of New Zealand. These regions were selected because of their proximity to the Sleep/Wake Research

Centre, and to create potential to reach enough pregnant Māori women to meet the wider study target of equal numbers of Māori and non-Māori participants, after considering birth rates for Māori women within each region. As well as posters and fliers, a wide variety of methods were used to advertise the study to pregnant women including:

- Face-to-face introduction of the study by the research team at antenatal classes and breastfeeding education classes.
- Information stands were set up at pregnancy and parenting related events such as the *Parent and Child Show* and public health expos.
- Print, radio and television media interviews and news releases were given over the course of the recruitment period.
- The media strategy also made use print and radio advertising.

The establishment of trusting relationships with recruitment sites was guided and enhanced by understandings of Māori research ethics. Māori customs and practices may be collectively described as Tikanga Māori. Three Tikanga Maori principles of whānaungatanga (kinship, relationship), manaakitanga (hospitality) and kaitiakitanga (guardianship) underpinned the Māori recruitment strategy. Examples of tikanga in this study include the sharing of food when meeting others and giving koha (a gift, contribution, or act of reciprocity) to participants and those who assisted with recruitment or other aspects of the project.

Women who expressed any interest in participation received a study information pack which contained a letter of introduction, a comprehensive information sheet, a consent form, the first questionnaire for completion between 35-37 weeks (should the woman choose to enrol), a self-addressed reply-paid questionnaire return envelope and two small samples of mother and baby related skincare products as an acknowledgement for considering participation in the study.[5] Women were also advised that they would receive a $20 koha in the form of a gift voucher on receipt of each of the two written questionnaires. A choice was offered between a supermarket, department store or petrol voucher. Copies of these documents can be found in Appendix 2.

After ten months of recruitment only 12% of enrolled women identified as Māori and it became clear that a refinement of recruitment processes was needed if the wider study target of equal numbers of Māori and non-Māori participants was to be met. Two key changes were implemented. First, enrolment in the study was closed to non-Māori women as the target sample size had already been exceeded. Ethnicity data was collected

[5] Skincare products for both studies were generously donated or supplied at cost to the project by Simunovich Olive Estate.

from all women who contacted the research team about study participation and this allowed entry restriction to women who self-identified as Māori. Second, the potential pool of participants was increased by making the sampling frame nationwide. So as to reach women in places distant from the research centre, a media and public relations campaign commenced and the study was promoted through main stream media (print, radio and television) as well as media directed to Māori audiences (print and radio). Information was sent to iwi (tribal) and Māori health organisations, with many groups assisting by forwarding information through their distribution lists. Information was also made available by having stalls at iwi cultural and sporting events around the country.

Local women, who lived in communities with high Māori birth rates, were also employed. These 'champions' of the research used their existing local knowledge and networks to promote the study and assist with recruitment. They put a face to the study and were able to answer questions and assist women with participation, all the while guided by local tikanga.

After extending the recruitment period in the project to rollout these revised strategies, and continuing to evolve and adjust the recruitment process, the final number of women who returned consent forms to participate in the E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand study was 1,186, of whom 423 identified as Māori.

Retention strategy

Longitudinal (repeated measures) research, such as this, requires vigilance and precision in tracking each participant's progress through the study's multiple stages. As soon as a consent form was received, the participant's details were entered into a purpose-designed Microsoft Access (2007 version) contact management and tracking database from which regular query reports were produced to ensure participants received surveys and koha in a timely fashion. To increase compliance a process of questionnaire completion follow-ups was instigated. This process used multiple modes including email, text message and telephone call, and was also tracked and managed through the Access database.

Procedure

Ethical and cultural considerations

Ethical approval was given by the New Zealand Health and Disability Ethics Committee, approval number CEN 09/09/070 (Appendix 3). All participants were supplied with written information sheets and consent forms to sign on enrolment in the study. Members of the research team were available via email, free telephone or text message services, to answer questions or help women complete the forms if required.

The consent form contained a section requesting permission to access information from clinical record databases relating to the women's birth experience. This information was obtained from either a District Health Board or the Ministry of Health National Minimum Datasets. It was stated in the information sheet for participants that opting out of this aspect of the study did not compromise their participation in the study in any way.

The consent form also contained a section relating to the minimisation of harm if women screened positive for symptoms of postnatal depression after completing a standardised screening instrument (EPDS, see page 75). The scale was scored as soon as a completed questionnaire was received at the research office. If a participant scored above established clinical cut-off criteria (greater than or equal to 13) or indicated any self-harm ideation (greater than 0 on scale item 10, *"the thought of harming myself has occurred to me"*), a comprehensive protocol for follow up was adhered to (Appendix 4). Women were first advised of their score on this screening tool and then they could choose to allow a member of the research team to contact their preferred health professional to share the same information (either by direct telephone contact, or by letter). If a woman met the criteria for follow up and had consented to a health professional being contacted, all other previous consent information was checked with her again to ensure she was still comfortable with her initial choices. Receiving this information could be distressing for some women and all members of the research team involved in this process had experience in maternal or mental health.

Cultural considerations

The relevance of self-identified ethnicity and equal numbers of participants to this study are explained in the Preface to this thesis. Preferred language was also taken into consideration in this study's design. Māori is one of two official languages in Aotearoa/New Zealand with special status in law (New Zealand Sign Language is the second official language with such status; English is the dominant language and a *de facto* official language). Bi-lingual versions of the consent form, cover letter and information

sheet were available on request. Questionnaires contained a number of standardised measures, none of which have been translated (and subsequently validated) into Te Reo Māori (the Māori language). Therefore, bi-lingual questionnaires were not available for participants, and it was a study requirement that participants were able to complete questionnaires in English. Only 4% of the New Zealand population speak Te Reo Māori, and almost all Māori who speak Te Reo Māori are bi-lingual, speaking English as well (Te Puni Kokiri, 2008). No participant was excluded as a result of the language criterion.

Measures

Participants completed three surveys in total. The first was a prenatal postal questionnaire completed in late pregnancy (Sleep and Health during Pregnancy questionnaire). The second was a postnatal telephone survey completed when infants were between 4-6 weeks old, and the third questionnaire was completed at 3 months postpartum (Postnatal Sleep and Health questionnaire). The three surveys are described in more detail as follows.

Sleep and Health during Pregnancy Questionnaire

Women were required to complete the Sleep and Health during Pregnancy questionnaire (51 questions, see Appendix 5) when they were between 35-37 weeks gestation. The questionnaire was developed during a prior feasibility study and comprises the following domains of interest: demographic information; maternal sleep; risk factors for postnatal depression; mental health; maternity/obstetric history and care; and general health. Only items relevant to the present study are described further.

Demographic information

Demographic information included maternal age, weeks' gestation, ethnicity, socio-economic status and employment status.

Gestation

The National Maternity Collection unit of Ministry of Health (2011), defines gestational age as "the duration of pregnancy in completed weeks at birth". Gestational age may be calculated using multiple methods including date calculated from the first day of a woman's last menstrual period (LMP) and her infant's date of birth, or from clinical assessment during pregnancy (including ultrasound scan), or from an examination of the infant after birth. The LMP method is the simplest and most common method for determining gestational age and/or estimated due date (Lynch & Zhang, 2007) and is based on an estimate of 280 days duration of pregnancy. In this study, number of weeks of gestation when completing the Sleep and Health during Pregnancy questionnaire was

calculated using maternal self-report of estimated due date (assuming the LMP method) and questionnaire completion date.

Ethnicity

Women reported their ethnicity using the ethnicity question of the New Zealand Census 2006 (Statistics New Zealand, 2006). Individuals could select more than one ethnicity in this question. Any woman who selected Māori as a single choice, or as part of multiple ethnicities, was counted as Māori. Women who selected any ethnicity except Māori were counted as non-Māori.

Socio-economic position

Two indicators of socio-economic position were utilised and these were income and an area index of deprivation (NZDep2006).

The New Zealand Census 2006 individual income question (Statistics New Zealand, 2006) asks responders to select a category into which their gross annual income for the previous 12 months falls. This item was modified so that participants were asked to select the category of their combined gross household income for the previous 12 months. In June 2012, the national median annual household income for New Zealanders, from all sources, was $67,808 (Statistics New Zealand, 2012).

NZDep2006 is the fourth version in a series of small area indexes of socioeconomic deprivation developed in New Zealand for use in resource allocation, research and advocacy (Salmond, Crampton, & Atkinson, 2007). This index is a well validated and reliable measure which has been used to investigate the relationships between socio-economic deprivation and a wide range of health outcomes in New Zealand, including rates of infectious disease (Baker et al., 2012), preterm birth (Ekeroma, Craig, Stewart, Mantell, & Mitchell, 2004) and psychiatric hospital admissions (O'Brien, Kydd, & Frampton, 2011). Data relating to eight dimensions of deprivation are drawn from nine census variables. The eight dimensions of deprivation are (in order of decreasing weight): income (adults receiving a means tested benefit and people living with income below an income threshold—equivalised for household composition); owned home; support (non-means tested benefits or benefits not necessarily associated with economic deprivation such as student allowances); employment status; educational qualifications; living space (bedroom occupancy); communication (access to telephone); and transport (access to a car). The statistical method of principal components analysis is used to create an index, which is scaled to have a mean 1,000 index points and standard deviation of 100 index points. From this a 10 point ordinal scale is derived, which splits New Zealand into tenths of the distribution of the first principal component scores applied to small area units

known as 'meshblocks'. Meshblocks are geographical units containing a median of 87 people in 2006. NZDep is a relative measure of deprivation (not absolute) therefore 10% of areas will always fall into the decile of highest deprivation. As a small-area measure of deprivation, scores apply to areas rather than individual people and the authors of the index caution that any index such as NZDep is only a proxy or partial measure (Salmond et al., 2007).

Using the address provided by each participant, an external agency matched individual subject ID's with a deprivation index value and this value was used in study analyses. When changes of address were identified between data collection time points, new addresses were re-matched for an up-to-date NZDep2006 value.

Employment status

Work schedules can affect sleep. In a study of employed nurses, women who permanently worked nights or rotating shifts reported the highest levels of sleep disturbance and excessive sleepiness when compared to those who worked evening and day shifts (Lee, 1992). Participants were therefore asked if they currently work for pay, profit or income, and, if 'yes', the average number of hours per week they were working (Statistics New Zealand, 2002). If 'yes' they were also asked how often they had worked between midnight and 5 a.m. in the last month and for how many hours (International Labour Organisation, 1990). If women were not currently working they were asked about their plans to return to paid work in the future.

Maternal sleep

Sleep quantity

Maternal sleep duration was measured with a single question asking how many hours sleep were usually obtained in 24 hours, including naps (Harris, 2003; Paine et al., 2004) prior to this pregnancy (as a retrospective report) and prospectively at 35-37 weeks pregnancy.

Sleep quality

Sleep quality is a multi-faceted construct and as such a range of measures were used as indicators of maternal sleep quality.

One of the key measures used to assess sleep quality was the General Sleep Disturbance Scale (GSDS; Lee, 1992). The GSDS is a validated measure which asks about the frequency of a range of sleep disturbing events in the last week. The full GSDS has previously demonstrated good internal consistency with reports of Cronbach alpha coefficients ranging from .80 to .88 in samples of employed women (Lee, 1992), healthy

and hospitalised perinatal women (Beddoe, Lee, Weiss, Powell Kennedy, & Yang, 2010; Gallo & Lee, 2008; Goyal et al., 2009) and in women from a range of cultures (Heilemann, Choudhury, Kury, & Lee, 2012; Lee, 2007). Concurrent validity has been demonstrated using sleep logs (r = .41) and wrist actigraphy (r = –.42; Lee, 2007).

Usually, 21 items are rated on a scale ranging from 0 (never) to 7 (everyday), with the possible total score ranging from 0 (no subjective sleep disturbance) to 147 (extreme subjective sleep disturbance). The GSDS contains seven subscales, and on each subscale a mean score of ≥3 indicates a clinically meaningful level of disturbance. This cut-off has previously been used to classify 'good' versus 'poor' sleepers (Gallo & Lee, 2008; Lee & Gay, 2011). The GSDS subscales pertain to sleep latency (item 1), sleep maintenance (item 2), early awakening (item 3), sleep quality (items 4, 5 and 10), sleep quantity (items 12 and 13), excessive daytime sleepiness (items 6, 7, 8 ,9, 11, 14 and 15) and the use of medication to promote sleep (items 16, 17, 18, 19, 20 and 21).

The medications subscale in the GSDS consists of six items relating to substances respondents may use to assist them to fall asleep such as alcohol, prescription and over-the-counter sleep medications and tobacco. Pregnant and lactating women are likely to abstain from or moderate their use of alcohol, tobacco and medications because of the possible implications for their infant. On advice from the scale's author, these items were modified and reduced in number to: item 16. use of prescription hypnotics; item 17. use of analgesia; and item 18. take anything else, with space to specify what else (K.A. Lee, personal communication, 11 July 2007). These changes did not affect any of the other six subscales and the total possible score for the full GSDS therefore became 126.

Another key measure used to capture sleep quality was self-reported number of good night's sleep per week. In the Sleep and Health during Pregnancy questionnaire women were asked to report the number of good night's sleep they obtained per week retrospectively (prior to the current pregnancy) and prospectively, at 35-37 weeks pregnancy (National Sleep Foundation, 2007).

To investigate sleep disturbance which might specifically relate to being pregnant, a measure of 16 common sleep disturbing factors was created for these studies based on previous studies investigating sleep in the perinatal period (Mindell & Jacobson, 2000; National Sleep Foundation, 2007). Women reported how many nights a week each factor disturbed their sleep, on a scale from 0 (no nights per week) to 7 (every night of the week). Items included common physical or environmental factors expected to disturb sleep during pregnancy, such as movements from the foetus, urinary frequency and nasal congestion. In-keeping with the rationale for dichotomising GSDS scores, scores on this measure were also cut so that scores greater than or equal to three represented greater

disturbance and scores less than three represented less disturbance. This measure included an 'other' category in which women could record sleep disturbing factors not already listed.

Introspective daytime sleepiness was measured using the Epworth Sleepiness Scale (ESS; Johns, 1991) which is one of the most frequently used instruments for assessing clinically significant sleepiness. The ESS is a validated measure (Hirshkowitz et al., 2011) which asks a respondent to predict the likelihood that they will "doze off" in eight everyday situations, such as watching television. Likelihood is rated as none (0), slight (1), moderate (2) or high (3). Scores of greater than 10 are categorised as excessive daytime sleepiness. Mean ESS scores of 6 for non-Māori and 7.5 for Māori have been reported in a large representative sample (n = 5,441) of healthy adult New Zealanders aged 30 to 60 years old (Gander, Marshall, Harris, & Reid, 2005).

Sleep disorders such as sleep disordered breathing and periodic limb movement disorder impact the quality of sleep by disrupting sleep continuity. Prenatal maternal snoring has also been implicated as a risk factor for adverse outcomes in pregnancy including depression (O'Brien, Owusu, & Swanson, 2013), caesarean section delivery and infants who are small for their gestational age (O'Brien, Bullough, et al., 2013) Based on three questions in the Pittsburgh Sleep Quality Index (Buysse et al., 1989), participants were asked to report how often in the previous week anyone had told them that they snored loudly or had long pauses between breaths while sleeping, both of which are symptoms of sleep disordered breathing. The same question applied to twitching or jerking leg movements during sleep, which is a symptom of periodic limb movement disorder. Responses were given on a scale of 0 = no nights to 7 = every night.

Restless legs syndrome is another sleep disorder which impacts sleep quality by disrupting normal sleep continuity and is more prevalent during pregnancy (Ohayon, O'Hara, & Vitiello, 2012). Participants reported if they ever experienced urges to move their legs (usually accompanied by unpleasant sensations). If a 'yes' response was made, diagnostic criteria were used to distinguish restless legs syndrome from general leg discomfort were asked: were symptoms 1) worse at night; 2) more noticeable during rest; and 3) relieved by movement (Ekbom & Ulfberg, 2009).

Perinatal distress

The main outcome variable in this study was the level of self-reported symptoms of postnatal depression at 3 months postpartum, using a standardised measure. The EPDS (Cox et al., 1987) is a 10-item self-report scale in which each item is scored on a 4-point scale (0–3) indicating increasing severity of the symptom. The total score can range from a

minimum of 0 to a maximum of 30. The scale takes less than 5 minutes to complete, is simple to score and requires no particular psychological training or expertise to use. The combination of these factors has contributed to the instrument's popularity in both clinical and research settings.

The scale's authors recommend a total score cut-off of greater than or equal to 13 to identify women with probable major depressive symptoms (the clinical cut-off) and greater than or equal to 10 to identify women with minor depressive symptoms (the community and research cut-off). Studies consistently report a score of greater than or equal to 13 as having good sensitivity (ranging from 68–95%) and specificity (ranging from 78–96%) to identity cases of major depression (Cox, Chapman, Murray, & Jones, 1996; Dennis, 2004; Murray & Carothers, 1990), as defined by the DSM-IV, although this is not the case across all ethnic groups or all studies. In a validation study with Tongan and Samoan women living in New Zealand, Ekeroma et al. (2012) found that cut-off values of greater than or equal to 10 and greater than or equal to 11 respectively were more appropriate. In another example, similar cut-off values were identified in a validation study of Norwegian women (Eberhard-Gran, Eskild, Tambs, Schei, & Opjordsmoen, 2001). A cut-off score of greater than 10 correctly identified all women who met the DSM-IV criteria for major depression, as validated by clinical interview (100% sensitivity), with 87% correct identification of true negative cases (that is, 87% specificity).

Following the work of Stuart et al. (1998), who identified common co-morbidity of depression and anxiety in the postpartum period, a study of 238 Australian women attending community antenatal classes aimed to investigate the validity of using the EPDS to screen for postnatal distress caseness, where "distress caseness" referred to meeting the criteria for either an anxiety or a depressive disorder, as determined by clinical interview (Matthey et al., 2001). In that study the optimal screening score to detect major or minor depression was 8/9 (with sensitivity of 70.8%, specificity of 75.7%) and the optimal cut-off for detecting cases of postnatal distress was 7/8 (with sensitivity of 70.3%, specificity of 73.1%).

Self-report measures may be less sensitive when depression is chronic (Cox et al., 1996) so using a lower cut-off score may be appropriate in the research setting when trying to understand prevalence rates and there is no cost to the institution for undertaking further clinical diagnostic processes, follow-up or treatment.

Clinical cut-off scores for the EPDS in New Zealand populations of Māori and the general non-Māori population have not yet been established. Because of this, it was decided to report prevalence of depressive symptoms for both the original community/research cut-off (greater than 9) and clinical cut-off (greater than 12) scores.

Use of the clinical cut-off allows comparison with existing literature and interpretation with relevance to the recognised clinical population and the clinical setting. Women scoring less than 13 on the EPDS are unlikely to meet the criteria for referral to specialist maternal mental health services in New Zealand. Potentially, therefore, a large number of women with subclinical symptoms of distress will not access specialist services, despite meeting criteria for further evaluation for postnatal depression, even though their daily functioning is likely to be compromised by poorer mood (Kabir, Sheeder, & Kelly, 2008). It was also considered important to determine the prevalence of less severely reported symptomology to allow interpretation and comparison with studies using lower cut-offs, such as two population-based studies conducted in Norway where, as with Tongan women, the cut-off of greater than 9 best predicts major depression (Dorheim, Bjorvatn, & Eberhard-Gran, 2012; Eberhard-Gran et al., 2001).

A brief version of the EPDS (EPDS-3A; Kabir et al., 2008; Matthey, 2008) was used during the telephone survey at 4-6 weeks postpartum. In an endeavour to find an ultra-brief screen for postnatal depression, which could be included in routine healthcare visits, abbreviated versions of the EPDS were evaluated by Kabir et al. (2008) with the 3-item version proving to have the best sensitivity (95%) and negative predictive value (98%) compared to 7-item and 2-item versions and using scores of greater than 9 on the full 10-item EPDS as the reference. Specificity for the 3-item scale in that study was 80%. Raw scores on the EPDS-3A can range from 0-9. An inflated score, to enable comparison with full EPDS-10 scores and cut-offs, was calculated by multiplying raw scores by a constant. The constant was calculated as 10 (the number of items in the full EPDS) divided by the number of items in the subscale, giving a constant of 3.33 (Kabir et al., 2008).

The EPDS-3A was also used to determine the level of anxiety symptoms in this study. Anxiety disorders such as generalised anxiety, panic disorder and obsessive compulsive disorder are often comorbid with depression and may present for the first time in the postnatal period (Metz, Sichel, & Goff, 1988; Stuart et al., 1998). In recent times, and because of its widespread use, the EPDS has been the subject of more detailed psychometric analyses which have consistently identified two potential dimensions of negative affect subsumed within the scale—depression and anxiety (Matthey, 2008; Reichenheim, Moraes, Oliveira, & Lobato, 2011). Findings show that items 3 (*I have blamed myself unnecessarily when things went wrong*), 4 (*I have been anxious or worried for no good reason*), and 5 (*I have felt scared or panicky for no very good reason*) represent anxiety and the remaining items representing depression. A number of other authors have further distinguished anhedonia from depression, with items 1 (*I have been able to laugh and see the funny side of things*), and 2 (*I have looked forward with enjoyment to things*),

representing anhedonia, and items 9 (*I have been so unhappy that I have been crying*) and 10 (*the thought of harming myself has occurred to me*) representing depression, with items 6 (*things have been getting on top of me*), 7 (*I have been so unhappy that I have had difficulty sleeping*), and 8 (*I have felt sad or miserable*) sometimes joining depression and sometimes joining anhedonia, depending on the study.

The Brief Measure of Worry Severity (BMWS; Gladstone et al., 2005) was also used to assess negative affect. Excessive worry and/or rumination are often experienced by individuals with mood disorders (Harvey, 2011) and perinatal women may be particularly affected by rumination about their infant or their efficacy as a mother. The BMWS is an 8-item measure including statements such as "*I worry that bad things or events are certain to happen*." Responses can be made according to four anchor points from 0 = not at all true to 3 = definitely true. Total possible scores range from 0–24. The BMWS was developed in order to assess severe or dysfunctional worry and has been shown to demonstrate good construct and clinical discriminant validity in a number of clinical and non-clinical populations. In one validation study, 748 women completed the BMWS in the third trimester of pregnancy and again at 8-weeks postpartum (Austin, Tully, & Parker, 2007). Strong internal consistency was shown (Cronbach's alpha = 0.89), and construct validity was established through correlations with other measures of negative affect including the EPDS. The BMWS also demonstrated predictive validity such that women who scored greater than 12 on the antenatal BMWS were 2.6 times more likely to report postnatal depression at 8-weeks postpartum than women who scored below this cut-off.

Risk factors for postnatal depression

Based on a review of the literature described in Chapter One, a number of factors were identified as being commonly associated with symptoms of postnatal depression. These are described with factors showing the strongest association with postnatal depression listed first.

History of mood disorder/prenatal symptoms of depression

Prior history and/or symptoms of depression during pregnancy are major risk factors for postnatal depression. Six questions were therefore used to assess individual and family history of depression. Three questions from the Pregnancy Risk Questionnaire (Austin, Hadzi-Pavlovic, Saint, & Parker, 2005) and Antenatal Risk Questionnaire (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013) were used to assess individual history of depression prior to, and during the current pregnancy, as well as any impact of depression on psychosocial function. One question also asked if treatment had been sought. One

additional question asked specifically about the history of prenatal or postnatal depression, and two other questions related to family history of prenatal or postnatal depression and family history of general depression or other mental health problem.

Social Support

As a proxy measure of social support, participants reported on two, single item, Likert-type scales which asked: 1) *If you have a partner, how is your relationship with them at the moment?*, where 0 = perfectly happy and 7 = extremely unhappy and 2) *how supportive of this pregnancy is your partner?,* where 0 = completely supportive and 7 = not at all supportive.

At least three types of social support have been identified according to their function: instrumental (including concrete or tangible support such as help with tasks or finances), information (advice and guidance) and emotional (availability of trust, concern and someone to listen) (availability of trust, concern and someone to listen; Östberg & Lennartsson, 2007). Based on previous literature, new questions about social support were included in this study. Women were asked to state if they received support from two social structures (within the home, and from outside of the home), and across four functions: financial, emotional (*"e.g. someone who listens or is 'there' for you"*), advice (*"e.g. can give information or guidance about baby care and parenting"*) and concrete/practical (*"e.g. baby care, housework, cooking"*), and from who ("e.g. *partner, friend, parent*").

Stressful life events

In the current study, a measure containing 13 statements about stressful personal events from the Pregnancy Risks Assessment Monitoring Systems (PRAMS) Phase 5, 2004-2008, (http://www.cdc.gov/prams/Questionnaire.htm) questionnaire was used to assess life stress. Participants were asked to indicate if any of the potentially stressful events had occurred for them in the last 12 months, such as moving house, losing their job (when they wanted to keep working) or being in a physical fight. PRAMS is an ongoing, joint research project between 44 state departments of health and the Centers for Disease Control and Prevention (CDC) in the United States of America. To date, the stressful personal events items have not been validated (I. Ahluwalia, PRAMS/CDC, personal communication, 10 September 2013).

General and obstetric health

A number of questions addressed maternal general and obstetric health and plans. These included: parity (the total number of times a woman had given birth, to an infant

who was alive or not, after 20 weeks gestation); if the current pregnancy was planned, and if women had used assisted reproductive technologies to become pregnant.

Postpartum Telephone survey

Between 4–6 weeks postpartum, participants were telephoned to complete a survey of sleep and mood. The date for initiating the call was determined from the estimated due date of birth supplied by women at enrolment. Infant age was established at the outset of the call and if this was less than 4 weeks the call was usually rescheduled to occur in the 4–6 week period. If birth had occurred prior to the estimated due date, meaning infant age was greater than 4-6 weeks, then the call proceeded as usual. These calls were designed to last between 3–5 minutes in duration and included questions about sleep quantity, number of sleep episodes and quality of sleep in the preceding 24-hours. The EPDS-3A was also completed during this call, scored immediately the call concluded, and follow-ups made according to the same guidelines as EPDS high scores in written questionnaires. A standardised schedule was followed when these calls were made and a copy of the schedule can be found in Appendix 6. Calls were initiated between 10 a.m. and mid-day so as not to disturb mothers too early in their day, whilst obtaining a measure of sleep and mood within a consistent time of day. This was not always possible as any requests by mothers to call at a different time were respected and adhered to.

Postnatal Sleep and Health Questionnaire

Between 11–13 weeks postpartum, women completed the 91-item Postnatal Sleep and Health questionnaire (see Appendix 7). Many items in the Sleep and Health in Pregnancy questionnaire are repeated in the Postnatal Sleep and Health questionnaire which also includes items pertaining to the birth experience as well as items relating to infant age, ethnicity, health, feeding, sleep habits and temperament. New measures in the Postnatal Sleep and Health questionnaire of relevance to Study One are described now.

Infant demographics

Ethnicity and infant age were determined in the same manner as for mothers.

Infant feeding

The World Health Organisation defines ‘exclusive breastfeeding’ as “the infant has received only breastmilk from his/her mother or a wet nurse, or expressed breastmilk, and no other liquids or solids with the exception of drops or syrups consisting of vitamins, mineral supplements or medicines” (World Health Organization, 1991). Exclusive breastfeeding is the research and clinical reference normative standard for infant nutrition, growth, health and development (American Academy of Pediatrics, 2012; World

Health Organization and UNICEF, 2009). Using this standard, mothers reported on their current method of feeding their infant (breast, artificial infant formula, or mixed method).

Infant sleep habits

To assess disruption to maternal sleep from infant waking, participants were asked to report on the usual frequency of infant night waking between 10 p.m. and 6 a.m. (Dennis & Ross, 2005), how many times during the previous night the mother woke to feed her baby and how many times during the previous night she woke to perform other infant care. Mothers also reported where their infant slept most of the time at night (which room) and what their infant slept in for most of the time at night (e.g. parent's bed, own cot). One item from the Brief Infant Sleep Questionnaire (Sadeh, 2004) was used to assess the degree to which mothers thought their infant's sleep was a problem. Response options were 1) not a problem at all, 2) a small problem and 3) a very serious problem.

Mood

As well as repeating the EPDS and BMWS, mood was assessed with two additional questions in the postnatal questionnaire. Prenatal symptoms of depression were assessed by asking if women experienced the presence of feelings of anxiety or depression, for 2-weeks or more during the most recent pregnancy, as well as the impact of symptoms, and whether or not professional help was sought (Austin et al., 2005).

Women also reported if they experienced the baby blues after this most recent birth. If the response was 'yes', duration was recorded where 0 = less than 1 day, 1 = 1–2 days, 2 = 3–7 days and 3 = more than a week.

Birth experience

Questions in this section related to gestation at birth, duration of labour (if labour was experienced), location of birth, mode of birth, and medical intervention at birth.

Sleep quality

The 16-item measure of common sleep disturbing factors used in the Sleep and Health in Pregnancy questionnaire was repeated in the postnatal questionnaire. Items relating to pregnancy were removed (such as disturbance from foetal movements) and new items relating to postnatal disturbance (such as disturbance from infant feeding) were added. The postnatal measure included 17 items.

Data management and analysis

Data from the Sleep and Health during Pregnancy and Postnatal Sleep and Health questionnaires were double-entered using Epi Info (Version 3.5.1) [Computer software]. Retrieved from http://wwwn.cdc.gov/epiinfo/, and the two databases were compared using the compare procedure of SAS (Version 9.1). Discrepancies were checked against the original questionnaire and one, final, corrected file was used for all analyses. Data from the postnatal telephone survey were first recorded on a standardised calling sheet and then entered into a database created in Microsoft Access (2007 version) for this study. These three databases were utilised in all subsequent analyses, and where necessary, variables of interest from the Sleep and Health during Pregnancy and Postnatal Telephone Survey were merged with data from the Postnatal Sleep and Health questionnaire.

A dataset was created which included all data from the 951 women who completed the postnatal written questionnaire between 11–13 weeks postpartum. Data from the prenatal questionnaire and postnatal telephone survey were then fused with this dataset, matching on participant identification number. Not all questionnaires were completed within the specified timeframes, meaning this dataset contained prenatal questionnaires completed when women were between 32–39 weeks gestation. (The completion specifier was 35–37 weeks gestation). Data from this questionnaire, regardless of completion date, was retained in the Study One dataset and is referred to as third trimester data (n = 927). Postnatal telephone surveys were completed from weeks 3–13 postpartum. (The completion specifier was 4–6 weeks postpartum). As the response values provided by later completers of the telephone survey were likely to overlap with responses in the three-month survey, only telephone survey data from women who completed this survey when their infant was less than 9-weeks old (the first two months postpartum) was retained in the dataset (n = 925). The data collected during the study related to four time points across the perinatal year and these are summarised in Table 2.

Table 2
Summary of questionnaires and timeframes used in the E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand study

	Sleep and Health in Pregnancy Questionnaire *n* = 927		Postnatal Telephone Survey *n* = 925	Postnatal Sleep and Health Questionnaire *n* = 951
Time frame notation	T1	T2	T3	T4
Refers to	Prior to Pregnancy (Retrospective)	3rd trimester (32-39 weeks gestation)	3-8 weeks postpartum	3-months postpartum (11–13 weeks postpartum)

Note. Numbers are total number of participants included for analyses in the E Moe, Māmā, Hauora Hinengaro study.

As part of the E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand study, women consented to their birth related clinical records being made available to the project. Most of the information in these records was not pertinent to the present study, however, clinical record data was accessed if maternal or infant date of birth, or ethnicity data were not supplied by participants in any of the written surveys.

SPSS (Version 20) was used to assess the amount and pattern of missing data for EPDS and GSDS scores. Apart from the GSDS Sleep Quality subscale (missing data = 3.68%), missing data for any single item or scale did not exceed 2%. When values were missing for all items on these scales, the values were left as missing; otherwise missing values were imputed using the subject mean of the subscale to which the item belonged (Fairclough & Cella, 1996; Shrive, Stuart, Quan, & Ghali, 2006). For all other items, no other data were imputed or sought from other sources.

The primary analytic strategy used was hierarchical (sequential) multiple linear regression to examine the main effect of sleep on postnatal depressive symptomology, after adjusting for a number of demographic and recognised risk factors for postnatal depression. Field (2010) recommends use of the SAS procedure PROC GLM to complete these computations in the form of an analysis of covariance (ANCOVA) because SAS automatically creates the dummy coded variables needed when including categorical variables in the calculations. ANCOVA allows for the inclusion of both categorical and continuous independent variables in the regression model. These analyses were performed using SAS, Version 9.3. Analyses were conducted in a series of steps as follows:

Step 1. Descriptive analyses were conducted and variables were screened to assess for accuracy, outliers, and the distributions of raw data. One outlier was identified in which a participant reported total sleep duration prior to pregnancy as 24-hours (in 24-hours) and this value was set to missing.

Step 2. Univariate tests were conducted to test for associations between individual independent variables and the outcome variable of EPDS at 11–13 weeks postpartum. If raw data was normally distributed Student's t-tests were calculated, otherwise, non-parametric tests including Mann-Whitney, Spearman's correlation, or Kruskal-Wallis were calculated.

Step 3. Variables to include in multivariate models were selected by evaluating the results of Step 2 against three criteria: 1) identification as a predictor variable that was significantly associated with the EPDS at 11–13 weeks postpartum; 2) the amount of missing data for each variable (as SAS excludes cases with missing data from analysis and retaining statistical power was considered essential); and 3) the hypothesised theoretical relevance of each variable.

A goal of the general linear regression approach used is to define a model with the fewest number of independent variables explaining the greatest amount of variance (Tabachnick & Fidell, 2013). The most commonly reported cut-off values for the EPDS are greater than 9 and greater than 13. In this sample, 155 participants scored greater than 9 and 74 participants scored greater than 12 on the EPDS. A general rule of thumb of 10 events (or cases) per variable has previously been described as affording acceptable power in regression analyses to detect meaningful effects (Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996). In this sample, case numbers of participants with depressive symptoms range from 74 to 155, depending on the cut-off applied, which allows for 7 to 15 variables to be included in these exploratory models.

Step 4. An initial global model was identified and all variables with potential to be included in the hierarchical analyses were entered simultaneously into a standard regression model to assess for collinearity and to further assist with selection of predictor variables. The model assumptions of absence of multicollinearity and singularity were met.

Step 5. The first ANCOVA executed included two blocks of covariates, and a third block of general sleep variables to see what, if any, relationships existed between sleep related variables and the outcome variable.

Next, in order to refine the explanation of the relationship between sleep and postpartum depression, separate models were created to test sleep duration variables and sleep quality variables. The first two blocks of covariates from the general sleep model were included in every subsequent model. As outlined in the Preface to this document, the three demographic variables of ethnicity, maternal age and socio-economic position (as measured byNZDep06 ranking) were included in all analytic models, and together they formed Block 1. Block 2 included three factors which have been established in prior

literature as strongly associated with postnatal depression: depressive symptoms in pregnancy (T2 EPDS scores), stressful life events, and social support using happiness in relationship with partner as a proxy for this construct. These variables were also shown to be related to the outcome variable in the univariate tests conducted in Step 2 above. Blocks of independent variables were entered into the model sequentially so as to be able to determine the change in the overall model fit; that is, the unique contribution to variance explained by each block, after controlling for variables in previous blocks. Eta-squared (η^2) is the regression coefficient produced in ANCOVA, and change in η^2 was used to quantify the effect of each block's contribution to the models.

Partial eta-squared (η^2_p) is a measure of effect size (Cohen, 1988; Fritz, Morris, & Richler, 2012; Pallant, 2007) and this was used to estimate the independent contribution of continuous predictor variables to the overall final model. When significant main effects were observed, *post hoc* tests, using Šidáks correction for multiple testing, were used to determine which levels within categorical independent variables were significantly different from each other (Field & Miles, 2010).

Chapter Three

Study One–E Moe, Māmā: Hauora Hinengaro

Results

The overall aim of the E Moe, Māmā: Hauora Hinengaro study was to investigate the relationship between perinatal sleep and maternal mood at 3 months postpartum. In order to do this it was first necessary to gain an understanding of the target population in terms of socio-demographic and birth related factors because of the impact these may have on both perinatal sleep and mood. It was also necessary to gain an understanding of usual non-pregnant sleep and sleep during pregnancy to allow investigation of how the *change* in sleep from one perinatal stage to another relates to postnatal mood. A similar understanding of maternal mood and mood history was also necessary before proceeding to the investigations of the primary focus of this study, which was the relationship between perinatal sleep and postnatal mood.

Description of participants

A detailed description of the study sample, including sleep and mood factors, is given in the following sections. This sample comprised the 316 Māori and 635 non-Māori women who completed the final questionnaire when their infants were aged between 11–13 weeks. All confidence intervals are reported at the 95% level. Recruitment for the E Moe, Māmā study took place over two years, from October 2009 to September 2011.

Maternal age and parity

Overall, the average age of women in the study was 31.1 years (SD = 5.69). Māori women were significantly younger (28.9 years, SD = 6.19) than non-Māori women (32.2 years, SD = 5.09), $t(949) = 8.70$, $p < .001$ (see also Table 3).

Table 3
Proportion of women by age

Age	Total %	% Māori (Lower-upper CI)		% non-Māori (Lower-upper CI)		χ^2	*p*
						76.54	**<.001**
<20	2.94	5.70	(3.63-8.82)	1.58	(0.86-2.87)		
20-24	11.36	21.84	(17.63-26.71)	6.14	(4.53-8.29)		
25-29	21.35	23.42	(19.09-28.39)	20.31	(17.37-23.62)		
30-34	34.49	27.53	(22.90-32.70)	37.95	(34.26-41.79)		
35-39	23.66	17.09	(13.34-21.63)	26.93	(23.63-30.51)		
>40	6.20	4.43	(2.66-7.30)	7.09	(5.34-9.35)		

Note. χ^2 is the Pearson chi square test. Boldface is significant at p = *.05.*

Socio-economic position

Proportions of women in each NZDep2006 area decile are shown in Table 4. The distribution of women in the area deciles differs significantly with Māori women over-represented in the areas of highest deprivation and non-Māori women over-represented in the areas of least deprivation.

Table 4
Proportion of women by area deprivation index

NZDep2006 Decile	Total %	% Māori (Lower-upper CI)		% non-Māori (Lower-upper CI)		χ^2	*p*
						117.8	**<.001**
1	13.37	5.70	(3.63-8.82)	17.19	(14.46-20.32)		
2	9.79	6.33	(4.13-9.57)	11.51	(9.26-14.23)		
3	9.16	4.75	(2.90-7.68)	11.36	(9.12-14.06)		
4	11.16	5.70	(3.63-8.82)	13.88	(11.41-16.79)		
5	12.11	13.92	(10.54-18.18)	11.20	(8.97-13.89)		
6	9.47	8.54	(5.94-12.15)	9.94	(7.84-12.51)		
7	9.58	13.92	(10.54-18.18)	7.41	(5.62-9.72)		
8	8.11	11.08	(8.07-15.01)	6.62	(4.94-8.83)		
9	7.79	11.08	(8.07-15.01)	6.15	(4.53-8.30)		
10	9.47	18.99	(15.05-23.67)	4.73	(3.33-6.67)		

Note. χ^2 is the Pearson chi square test. Boldface is significant at p = *.05.*

Overall, 57% of women were taking parental leave at T4. Non-Māori women (63%) were more likely to be on parental leave than Māori women (46.1%) at this time, χ^2 (1) = 21.6, p <.001.

Pregnancy, birth and breastfeeding

Women were pregnant with anywhere from their first (51%), second (31%) up to a tenth baby. Māori women were more likely than non-Māori women to have given birth at least once before the current pregnancy (see Table 5.) On average, infants in the study were born at full term gestation (see Table 5) and this reflects the requirement for the first study questionnaire to be completed when women were at, or near full term of their pregnancy, at 35–37 weeks gestation.

Table 5
Average parity and gestation at birth

Variable	Total Mean (SD)	Māori Mean (SD)	non-Māori Mean (SD)	*t*	*df*	*p*
Parity	0.80 (1.09)	1.14 (1.36)	0.64 (0.90)	-6.62	909	**<.001**
Infant gestation at birth (weeks)	39.63 (1.61)	39.58 (1.59)	39.65 (1.62)	0.65	646	.518

Note. t is the Student's t-test statistic, df is degrees of freedom. Boldface is significant at p *= .05.*

Table 6 summarises data related to pregnancy, mode of childbirth, and breastfeeding status at 3 months postpartum. Non-Māori women were significantly more likely than Māori women to have planned the current pregnancy. They were also more likely to have used assisted reproductive technologies such as in vitro fertilisation.

Most women in the study (91%) gave birth in the place they had planned. For 86% of women (88% Māori, 92% non-Māori) this was in a hospital or community based maternity facility, and for 4.5% of women (6.3% Māori, 3.6% non-Māori) this was at home. The birth experience became an unplanned home birth for 1.3% of women (1.9% Māori, 1.1% non-Māori) and an unplanned hospital birth for 1.7% of women (1.3% Māori, 2.0% non-Māori). For 6% of women (7.9% Māori, 4.4% non-Māori) birth occurred in a different maternity facility to the one they had planned and two women gave birth in vehicles on their way to hospital (one each Māori and non-Māori).

A large number of women received medical intervention in some form during labour and birth (see Table 6). Labour was induced for almost one quarter of all women with no significant difference by ethnicity. Non-Māori women were more likely than Māori women to receive epidural anaesthesia during labour and childbirth. In total 33% of women received medical assistance to birth their infant (instrumental deliveries and caesarean sections). Almost 10% of women were anticipating, and gave birth by, caesarean section (planned caesarean sections). A number of these were classified as an emergency planned caesarean section. Caesarean section procedures are classified as emergency whenever they occur at a time that was not previously scheduled. The use of the word 'emergency'

therefore implies unscheduled rather than necessarily being a crisis event. Significantly more non-Māori than Māori women gave birth by emergency unplanned caesarean.

At three months postpartum just over half of all women were exclusively breastfeeding their infants. At the same time, the proportion of all infants that had received only artificial infant formula in the preceding 48-hours was 13.5%. Māori infants (18%) were more likely than non-Māori infants (11.2%) to have received only artificial infant formula in the preceding 48-hours, $\chi^2(1) = 8.41$, $p = .004$.

Table 6
Descriptive statistics related to pregnancy, intervention at birth and breastfeeding

Variable	Total %	% Māori (Lower-upper CI)		% non-Māori (Lower-upper CI)		χ^2	p
Planned pregnancy	67.97	45.15	(39.61-50.82)	78.88	(75.51-81.90)	105.68	**<.001**
Assisted reproductive technology	4.86	2.00	(0.92-4.29)	6.23	(4.59-8.40)	7.85	**.005**
Medical intervention at birth							
Induction of labour	23.66	19.94	(15.90-24.69)	25.51	(22.28-29.04)	3.63	.056
Epidural anaesthesia	41.47	29.11	(24.38-34.35)	47.63	(43.77-51.52)	29.80	**<.001**
General anaesthesia	2.57	2.88	(1.52-5.37)	2.42	(1.47-3.95)	0.18	.675
Instrumental vaginal delivery (forceps/vacuum)	9.99	7.59	(5.16-11.05)	11.18	(8.96-13.87)	3.02	.082
Planned caesarean section	8.20	5.70	(3.63-8.82)	9.45	(7.41-11.97)	3.65	**.047**
Emergency planned caesarean section	1.68	0.95	(0.32-2.75)	2.05	(1.20-3.47)	1.54	.215
Emergency unplanned caesarean section	13.25	9.81	(7.00-13.59)	14.96	(12.40-17.95)	4.87	**.027**
Exclusive breastfeeding	55.11	50.32	(44.83-55.79)	57.50	(53.62-61.30)	4.40	**.035**

Note. χ^2 is the Pearson chi-squared statistic. Boldface is significant at p = *.05.*

Changes in perinatal sleep and mood

Objective 1 of this study was to investigate the change in sleep and mood across the perinatal period in New Zealand women. As outlined in Chapter One, a number of factors can influence the amount and quality of sleep that women obtain in the perinatal year. A number of risk factors have also previously been identified as predisposing women to postnatal depression. Results relating to such factors are described in the following section so as to provide greater understanding of the extent of sleep and mood changes in pregnant and postpartum women. This description provides the context for understanding the role that behavioural, cognitive, physiological, emotional and environmental factors have in changes to sleep and mood at this time.

Maternal sleep duration

Prior to pregnancy, sleep duration was significantly higher for Māori women compared to non-Māori women (see Table 7). By the last trimester of pregnancy, sleep duration was at its lowest level during the study and had reduced by an average of 62 minutes for Māori and 47 minutes for non-Māori women. By 11–13 weeks postpartum, average sleep duration increased again but had not returned to pre-pregnancy baseline levels for either group. Women were categorised as short (≤6 hours), normal (>6 to ≤9 hours), or long (>9 hours) sleepers. At 11–13 weeks postpartum the sleep duration was in the normal range for the majority of women (see Table 8). Māori were more significantly more likely to be long sleepers than non-Māori women, and non-Māori were more likely than Māori women to obtain sleep in the normal range.

Table 7
Descriptive statistics for total sleep duration in 24-hours

Time	Total Mean (SD)	Māori Mean (SD)	non-Māori Mean (SD)	*t*	*df*	*p*
T1	8.19 (1.15)	8.46 (1.51)	8.06 (0.91)	-5.04	923	**<.001**
T2	7.34 (1.77)	7.47 (2.04)	7.28 (1.62)	-1.52	919	.128
T3	7.55 (1.76)	7.64 (2.04)	7.50 (1.60)	-1.10	923	.273
T4	7.48 (1.45)	7.76 (1.88)	7.34 (1.16)	-4.20	939	**<.001**

Note. t is the Student's t-test statistic, df is degrees of freedom. Boldface is significant at p = *.05.*

Table 8
Proportion of women by sleep duration type at 3 months postpartum

Sleep duration	Total %	% Māori (Lower-upper CI)	% non-Māori (Lower-upper CI)	χ^2	*p*
Short, ≤ 6 hours	19.45	21.52 (17.34-26.38)	18.43 (15.60-21.63)	1.35	**.246**
Normal, > 6 and ≤ 9 hours	72.35	63.29 (57.85-68.42)	76.85 (73.41-79.64)	19.28	**<.001**
Long, > 9 hours	7.15	13.92 (10.54-18.18)	3.78 (2.55-5.56)	32.92	**<.001**

Note. χ^2 *is the Pearson chi-squared statistic. Boldface is significant at* p = *.05.*

Change in sleep duration

A change to usual sleep duration was reported by almost all women at some point in the study. Overall, by the third trimester of pregnancy sleep duration had decreased from usual non-pregnant TST for 63.5% of women. For 21.2% the decrease was up to one hour, and for 42.3% the decrease was greater than one hour. No change in usual sleep duration from prior to pregnancy to 3rd trimester was reported by 13.4% of women. For 23.1% of women sleep duration increased across this time. For 11.4% of women the increase was up to one hour, and for 11.7% the increase was greater than one hour.

By postnatal T3, 54.8% of women were experiencing a decrease in sleep duration from their usual non-pregnant TST. For 20.8% the decrease was up to one hour, and for 34% of women, the decrease in TST was more than one hour. No change in usual TST was experienced by 19% of women and for 26.2% usual TST increased; 14.4% reported an increase of up to one hour, and 11.8% reported an increase of more than one hour.

At 3 months postpartum, 62.5% of women reported a decrease from their usual pre-pregnant sleep duration. For 33% of women this decrease was up to one hour and for 29.5% the decrease was greater than one hour. Twenty-one percent reported the same TST for T1 and T4 indicating that sleep duration had either not changed, or had recovered to their usual non-pregnant TST. At T4, 16.5% of women reported an increase in usual sleep duration; 10.9% reported an increase of up to one hour and 5.6% reported an increase of greater than one hour.

Maternal sleep quality

A number of facets of sleep quality were measured in this study including the number of good night's sleep obtained per week, general sleep disturbance and excessive daytime sleepiness and these are reported in Table 9. There were no differences by ethnicity in the number of good night's sleep reported at any time. Women obtained the least number of good night's sleep in late pregnancy. Although the number of good night's sleep improved by three months postpartum, this aspect of sleep quality had not returned to the level reported prior to pregnancy.

Sleep disturbance was also investigated using the GSDS and results are shown in Table 9. Mean scores greater than or equal to three on the GSDS indicate sleep disturbance at a clinically meaningful level. The greatest level of sleep disturbance was seen in late pregnancy when women reported difficulty with staying asleep (sleep maintenance), waking too early, sleep quality and the effects of excessive sleepiness on daytime functioning. Total GSDS scores were also highest at this time.

Table 9
Descriptive statistics for sleep quality variables

Variable	Time	Total Mean (SD)	Māori Mean (SD)	non-Māori Mean (SD)	*t*	*df*	*p*
Good night's sleep	T1	5.26 (1.46)	5.18 (1.48)	5.30 (1.46)	1.16	925	.244
	T2	2.61 (1.85)	2.54 (1.73)	2.65 (1.90)	0.88	923	.381
	T4	3.59 (2.26)	3.73 (2.25)	3.52 (2.26)	-1.31	941	.189
General Sleep Disturbance Scale							
Sleep onset	T2	2.65 (2.34)	3.16 (2.47)	2.41 (2.24)	-4.59	923	**<.001**
	T4	1.39 (1.70)	1.53 (1.78)	1.32 (1.65)	-1.79	946	.073
Sleep maintenance	T2	6.26 (1.54)	6.05 (1.69)	6.36 (1.45)	2.84	924	**.005**
	T4	4.46 (2.73)	4.10 (2.84)	4.63 (2.66)	2.81	946	**.005**
Early awakening	T2	4.24 (2.41)	4.30 (2.26)	4.21 (2.48)	-0.51	920	.608
	T4	2.74 (2.67)	2.61 (2.54)	2.81 (2.73)	1.10	946	.272
Sleep Quality	T2	4.07 (1.36)	4.19 (1.35)	4.01 (1.37)	-1.84	908	.067
	T4	2.87 (1.45)	2.81 (1.48)	2.90 (1.44)	0.91	946	.366
Daytime functioning	T2	3.93 (1.58)	4.01 (1.54)	3.89 (1.59)	-1.08	910	.279
	T4	2.90 (1.60)	2.81 (1.60)	2.95 (1.60)	1.21	946	.225
Total GSDS	T2	61.06 (17.33)	61.82 (16.67)	60.69 17.64	-0.90	878	.369
	T4	46.72 (18.53)	45.76 (18.58)	47.20 (18.50)	1.13	946	.259

Note. Good night's sleep and GSDS subscales are reported as mean number of night's per week. t is the Student's t-test statistic, df is degrees of freedom. Boldface is significant at p = *.05.*

Symptoms of sleep disorders

Information relating to the number of nights per week that women experienced events associated with sleep disorders, such as pauses in breathing, periodic limb movements, and snoring are presented in Table 10. In this sample, changes in snoring patterns were observed from prior to pregnancy to late pregnancy. Among Māori women, 58% reported never snoring, 13% started snoring in pregnancy, 13% stopped snoring in pregnancy and 16% snored before and during pregnancy. The majority of non-Māori women never snored (66%), 18% starting snoring during pregnancy and 7% stopped, while 9% snored before and during pregnancy. Table 11 shows the proportion of women who met the criteria for restless legs syndrome in late pregnancy and at 3 months postpartum.

Table 10
Descriptive statistics for symptoms of sleep disorders (nights per week)

Variable	Time	Total Mean (SD)	Māori Mean (SD)	non-Māori Mean (SD)	*t*	*df*	*p*
Snoring	T1	0.87 (1.53)	1.25 (1.82)	0.69 (1.34)	-5.31	913	**<.001**
	T2	1.30 (2.20)	1.33 (2.20)	1.29 (2.20)	-0.30	912	.766
	T4	0.40 (1.17)	0.54 (1.43)	0.33 (1.02)	-2.60	941	**.010**
Pauses in breathing	T1	0.15 (0.68)	0.22 (0.85)	0.12 (0.58)	-2.09	898	.037
	T2	0.21 (0.96)	0.25 (1.06)	0.18 (0.90)	-1.02	900	.306
	T4	0.04 (0.40)	0.04 (0.34)	0.05 (0.43)	0.28	936	.783
Leg twitching	T1	0.88 (1.67)	1.19 (1.97)	0.73 (1.48)	-3.94	910	**<.001**
	T2	0.76 (1.70)	1.02 (2.00)	0.63 (1.52)	-3.08	906	**.002**
	T4	0.22 (0.92)	0.34 (1.14)	0.16 (0.79)	-2.80	937	**.005**

Note. t is the Student's t-test statistic, df is degrees of freedom. Boldface is significant at p *= .05.*

Table 11
Proportion of women meeting the criteria for restless legs syndrome

Time	Total %	% Māori (Lower-upper CI)	% non-Māori (Lower-upper CI)	χ^2	*p*
T2	16.72	14.33 (10.82-18.75)	17.86 (15.06-21.05)	1.82	.178
T4	5.89	4.43 (2.66-7.30)	6.61 (4.93-8.82)	1.82	.178

Note. χ^2 *is the Pearson chi-squared test statistic. Boldface is significant at* p *= .05.*

Other sources of sleep disturbance

A number of other pathological sources of potential sleep disturbance were also investigated and these are presented in Table 12. These proportions represent the number of women who were being monitored or treated for the condition and do not include other women who may have had symptoms but were not receiving medical care.

Table 12
Other pathological sources of potential sleep disturbance at 11–13 weeks postpartum

Variable	Total %	% Māori (Lower-upper CI)	% non-Māori (Lower-upper CI)	χ^2	*p*
Birth related pain	2.96	3.17 (1.73-5.74)	2.85 (1.81-4.46)	0.08	.783
Mastitis	3.06	2.22 (1.08-4.50)	3.48 (2.31-5.21)	1.14	.286
Infection	1.27	0.95 (0.32-2.75)	1.42 (0.75-2.68)	0.38	.537
Anaemia	11.50	14.56 (11.09-18.87)	9.97 (7.87-12.55)	4.36	**.037**
Urinary incontinence	1.16	0.95 (0.32-2.75)	1.27 (0.64-2.48)	0.18	.668
Faecal incontinence	1.05	1.27 (0.49-3.21)	0.95 (0.44-2.06)	0.20	.653

Note. χ^2 *is the Pearson chi-squared test statistic. Boldface is significant at* p *= .05.*

Figure 8 and Figure 9 show the proportion of women reporting high disturbance (on three or more nights per week) from each of a range of sleep disturbing factors, during the third trimester and at 11–13 weeks postpartum respectively. Discomfort and nocturnal urinary frequency caused the most disturbance in late pregnancy, and nocturnal infant feeding was the most common disturbance at 11–13 weeks postpartum. The category 'other' included reports of disturbance from pets, environmental noise, hunger, thirst, illness, pain, getting up to express breastmilk, checking infant and earthquakes.

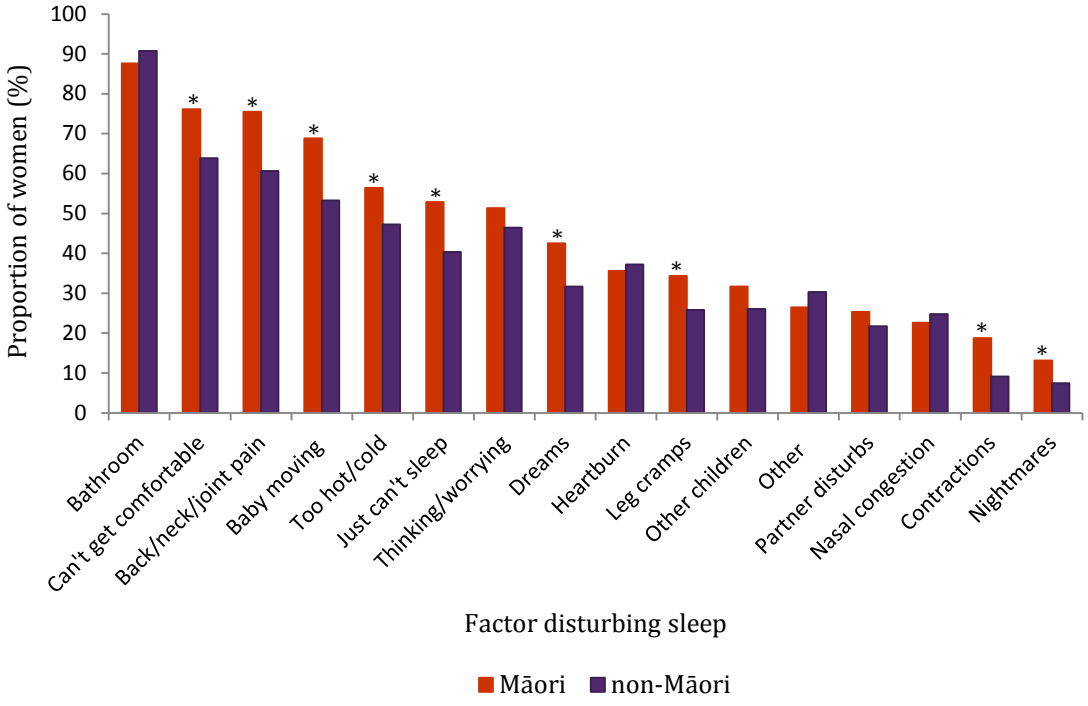

Figure 8. Sleep disturbing factors and the proportion of women affected by each factor, at 35-37 weeks of pregnancy. * Indicates significant at $p = .05$.

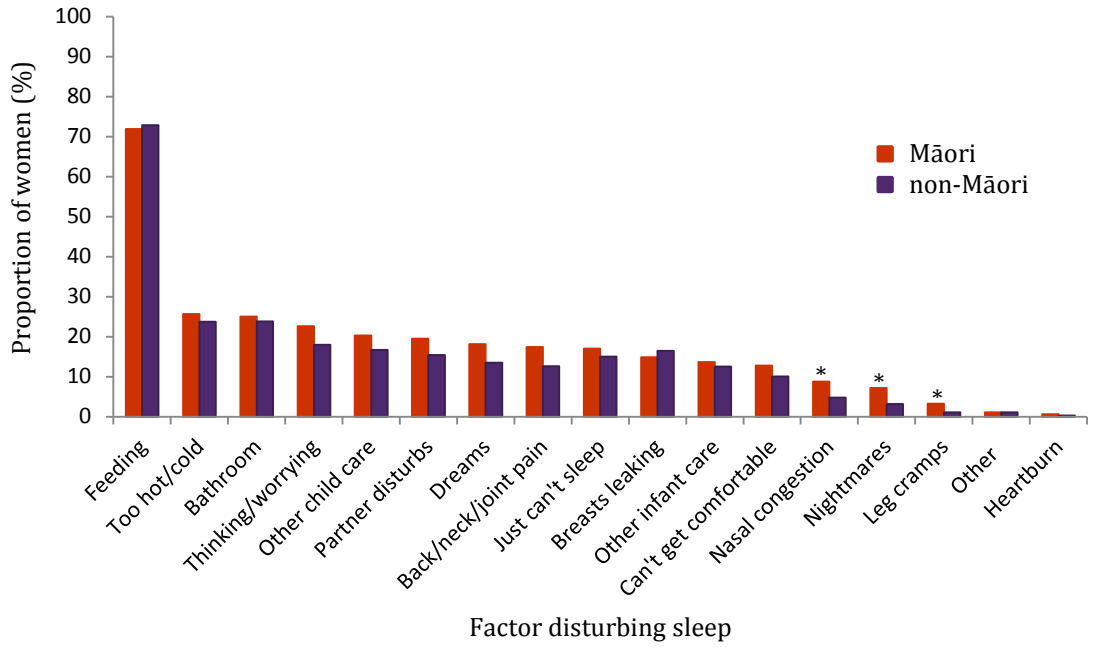

Figure 9. Sleep disturbing factors and the proportion of women affected by each factor, at 11–13 weeks postpartum. * Indicates significant at $p = .05$.

Women reported the number of times they had been woken during the previous night to feed their infant or provide other infant care. More than 75% of women were woken at least once to feed their infant (see Figure 10), and 20% woke to carry out other infant care (see Figure 11). At 11–13 weeks postpartum, women reported the number of times their infant usually woke between 10 p.m. and 6 a.m.

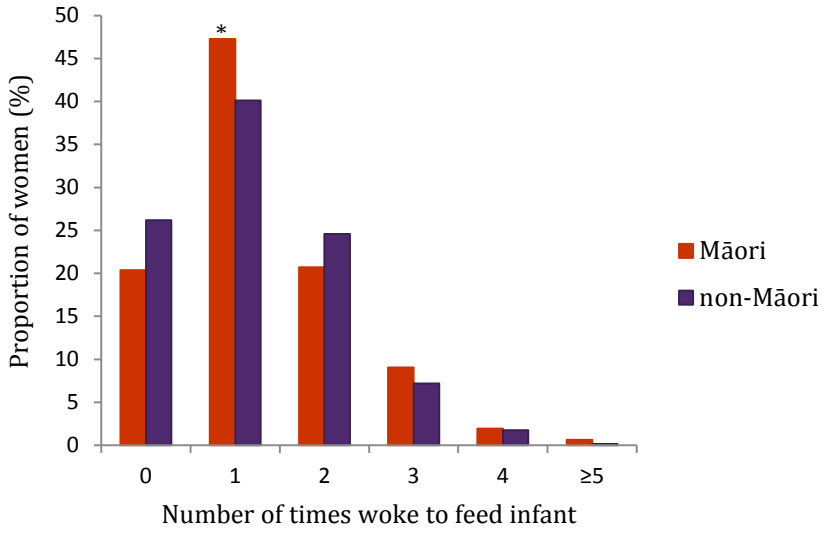

Figure 10. Number of times women woken on the previous night to feed their infant, at 3 months postpartum. * Indicates significant at $p = .05$.

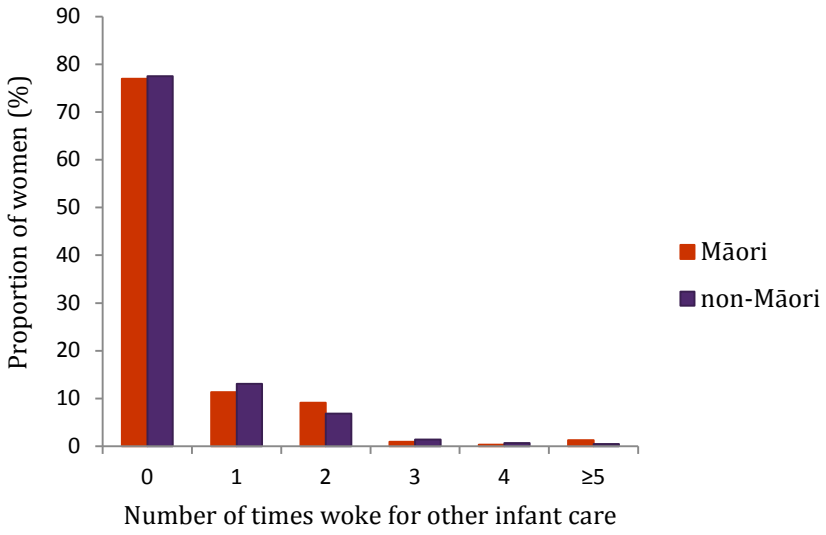

Figure 11. Number of times women woke on the previous night to carry out infant care, other than feeding, at 3 months postpartum.

More than 80% of infants were waking at least once per night, and 36% were waking more than once per night at this time (see Figure 12).

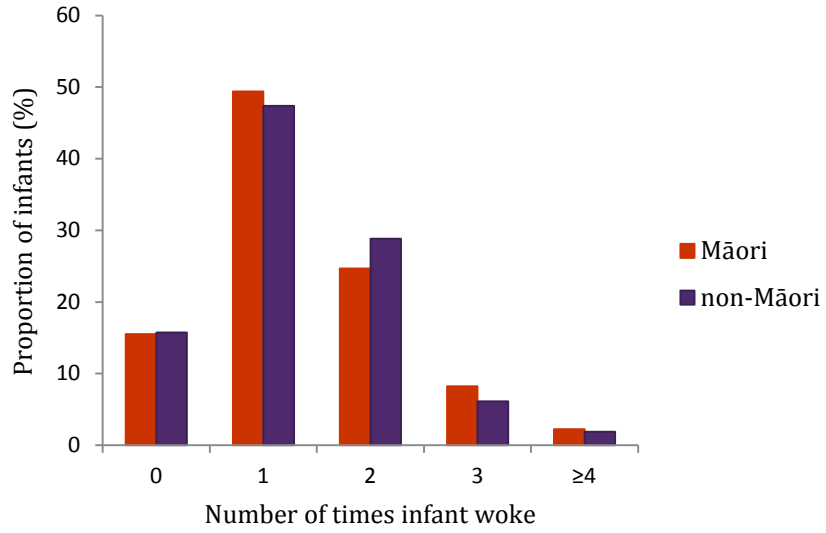

Figure 12. Number of times women reported that infant usually woke at night, at 3 months postpartum.

Daytime sleepiness

Scores on the Epworth Sleepiness Scale were highest in late pregnancy, and at this time scores were significantly higher for Māori than non-Māori women (see Table 13). During pregnancy 19% of women were classified as having excessive daytime sleepiness (ESS>10). Significantly more Māori (23%) than non-Māori (17%) reported excessive daytime sleepiness, $\chi^2(1) = 4.11$, $p = .043$. At 3 months postpartum, 13% of women were classified as having excessive daytime sleepiness. There was no significant difference, $\chi^2(1) = 1.01$, $p = .314$, between rates of excessive daytime sleepiness for Māori (15%) and non-Māori (12%) women at this time.

Table 13
Descriptive statistics for daytime sleepiness using the Epworth Sleepiness Scale

Time	Total Mean (SD)	Māori Mean (SD)	non-Māori Mean (SD)	*t*	*df*	*p*
T2	7.09 (3.97)	7.59 (4.19)	6.85 (3.84)	-2.65	905	**.008**
T4	5.97 (3.86)	6.25 (3.88)	5.83 (3.84)	-1.55	933	.120

Note. t is the Student's t-test statistic, df is degrees of freedom. Boldface is significant at p *= .05.*

Infant sleep

Women were asked about the location of their infant for sleep *most* of the time at night. Māori women were significantly more likely to have their infant sleep in the same room as them and in bed with them at night than non-Māori women (see Table 14). Non-Māori women were more likely to report that their infant's sleep was a problem than Māori women at 3 months postpartum (see Table 15).

Table 14
Usual location of infant for sleep at night at 11–13 weeks postpartum

Sleep location	Total %	% Māori (Lower-upper CI)	% non-Māori (Lower-upper CI)	χ^2	*p*
Parents room	61.96	76.75 [71.77-81.08]	54.65 [50.76-58.48]	43.56	**<.001**
Own room	36.67	21.66 [17.46-26.54]	44.09 [40.28-47.98]	45.55	**<.001**
Parents bed	8.44	14.33 [10.89-18.64]	5.52 [4.00-7.58]	21.10	**<.001**

Note. χ^2 is the Pearson chi-squared statistic. Boldface is significant at p *= .05.*

Table 15
Maternal reporting of infant sleep as a problem at 11–13 weeks postpartum

Level of infant sleep problem	Total %	% Māori (Lower-upper CI)		% non-Māori (Lower-upper CI)		χ^2	*p*
						6.67	**.036**
No problem at all	76.63	81.65	[77.01-85.53]	74.13	[70.59-77.39]		
A small problem	22.63	17.72	[13.91-22.31]	25.08	[21.86-28.60]		
A very serious problem	0.74	0.63	[0.17-2.28]	0.79	[0.34-1.83]		

Note. χ^2 is the Pearson chi-squared statistic. Boldface is significant at p = *.05.*

Social support

Partner relationship

At 11–13 weeks postpartum 56% of Māori women reported their partner relationship to be a happy one, 21% reported neutral feelings, 14% reported feeling unhappy in this relationship and 9% reported that this question did not apply to them. Three quarters of non-Māori women reported their partner relationship to be happy (76%), 14% reported neutral feelings, 9% reported feeling unhappy in this relationship and 1% reported that this question did not apply to them.

Support

Social support was also reported across two structural dimensions—support from within the home, and support from outside of the home. A high proportion of women received financial and concrete support within the home (see Table 16.) A high proportion of women also received emotional support within the home and from outside of the home. Women were more likely to receive support in the form of advice, information and guidance from outside of the home than inside the home.

Table 16
Proportion of women receiving support within the home and from outside the home

Source and type of support	Total %	% Māori (Lower-upper CI)		% non-Māori (Lower-upper CI)		χ^2	*p*
In home							
Financial	91.93	85.94	[81.65-89.36]	94.91	[92.91-96.37]	22.67	**<.001**
Emotional	93.11	86.94	[82.77-90.23]	96.18	[94.39-97.42]	27.83	**<.001**
Advice	70.31	70.06	[64.78-74.86]	70.43	[66.75-73.86]	0.01	.908
Concrete	92.45	86.58	[82.36-89.92]	95.38	[93.45-96.77]	23.19	**<.001**
Out of home							
Financial	56.69	63.38	[57.92-68.51]	53.34	[49.43-57.21]	8.58	**.003**
Emotional	97.66	96.81	[94.22-98.26]	98.09	[96.70-98.91]	1.51	.218
Advice	97.13	96.81	[94.22-98.26]	97.29	[95.71-98.30]	0.18	.672
Concrete	75.74	77.96	[73.04-82.19]	74.64	[71.09-77.89]	1.25	.264

Note. χ^2 is the Pearson chi-squared statistic. Boldface is significant at p = *.05.*

Mood

Table 17 shows the proportions of women reporting a prior history of mood disturbance, the proportions of women reporting mood disturbance during the study and the proportions of women who sought help for mood disturbance. One third of all women reported a prior history of mood disturbance and more non-Māori than Māori women reported this to be the case. Of the women who did report a prior history of mood disturbance, almost two thirds (63%) reported that they sought professional help for this. Māori women were more likely than non-Māori women to report previously experiencing antenatal or postnatal depression.

Mood disturbance in the current pregnancy was assessed in the third trimester using the question *"During this pregnancy, have you been distressed by feelings of anxiety or depression for 2 weeks or more?"* Mood disturbance during pregnancy was also assessed retrospectively at T4 by asking women *"During this most recent pregnancy were you distressed by feelings of anxiety or depression for 2 weeks or more?"* More women reported that they had experienced prenatal mood disturbance when asked at 3 months postpartum than in the third trimester. Fewer women sought professional help for mood disturbance during pregnancy than prior to pregnancy.

Table 17
Proportion of women reporting historical/current mood disturbance and help seeking

	Total %	% Māori (Lower-upper CI)		% non-Māori (Lower-upper CI)		χ^2	*p*
History of mood Disturbance	33.66	27.67	(22.91-32.99)	36.52	(32.85-40.36)	7.13	**.008**
Sought help for mood disturbance	62.62	54.88	(44.13-65.19)	65.37	(59.03-71.21)	2.84	.092
Previous diagnosis of depression	24.97	21.07	(16.83-26.04)	26.84	(23.51-30.44)	3.59	.058
History ante/postnatal depression	10.10	15.54	(11.86-20.11)	7.52	(5.70-9.86)	14.23	**<.001**
Mood disturbance this pregnancy – T2	14.84	18.46	(14.46-23.25)	13.12	(10.70-15.99)	4.55	**.033**
Sought help for prenatal mood disturbance – T2	41.13	33.33	(22.49-46.28)	46.43	(36.15-57.02)	2.40	.121
Mood disturbance most recent pregnancy – T4	20.89	26.03	(21.50-31.15)	18.33	(15.51-21.53)	7.56	**.006**
Sought help for prenatal mood disturbance – T4	35.92	33.33	(24.32-43.76)	37.82	(29.61-46.78)	0.44	.508
Family history ante/ postnatal depression	15.77	18.31	(14.31-23.12)	14.54	(11.97-17.56)	2.12	.145
Family history mental health problem	43.53	42.62	(37.13-48.29)	43.96	(40.11-47.89)	0.15	.700
Baby blues	63.89	58.77	(53.22-64.03)	66.46	(62.69-70.03)	5.44	**.020**
Prolonged baby blues	26.58	25.14	(19.41-31.89)	27.21	(23.17-31.66)	0.28	.597

Note. χ^2 is the chi-squared statistic. Boldface is significant at p = *.05.*

Baby blues

Almost two-thirds of women experienced the baby blues (see Table 17). For more than a quarter of women the blues were prolonged, lasting at least a week or longer. Non-Māori women were more likely than Māori women to report experiencing the blues at all, but there was no difference by ethnicity for reporting prolonged blues. Overall, women who experienced prolonged baby blues reported significantly higher levels of depressive symptoms at three months postpartum (mean 7.85, *SD* = 5.3) than those who did not (mean 5.57, *SD* = 3.9), $t(600) = -5.73$, $p < .001$.

Depression

Using total EPDS scores, women reported higher levels of depression in the third trimester of pregnancy than at 3 months postpartum (see Table 18). Māori women reported higher levels than non-Māori at T2, but not at T4.

Anxiety and worry

There were no differences by ethnicity in anxiety levels, as measured by the EPDS-3A and shown in Table 18. Anxiety levels were highest in late pregnancy and lowest at 3–8 weeks postpartum. Overall, women also reported higher levels of worry (BMWS) in late pregnancy than at 3 months postpartum (see Table 18) and there was no difference by ethnicity.

Stressful life events

Exposure to stressful life events was a common occurrence. At T4 Māori women had experienced significantly more stressful life events in the preceding 12 months compared to non-Māori women (see Table 18).

Table 18
Descriptive statistics for perinatal distress related variables

Variable	Time	Total Mean (SD)		Māori Mean (SD)		non-Māori Mean (SD)		*t*	*df*	*p*
EPDS Total	T2	7.98	(4.80)	8.86	(4.97)	7.57	(4.66)	-3.85	925	**<.001**
EPDS Total	T4	5.59	(4.24)	5.96	(4.54)	5.40	(4.08)	-1.97	947	.058
EPDS-3A	T2	12.17	(7.12)	12.80	(6.98)	11.88	(7.17)	-1.85	925	.065
EPDS-3A	T3	8.14	(6.24)	8.15	(6.50)	8.13	(6.11)	-0.04	921	.969
EPDS-3A	T4	8.27	(6.41)	8.51	(6.56)	8.14	(6.33)	-0.84	947	.401
BMWS	T2	6.35	(4.86)	6.26	(5.03)	6.39	(4.78)	0.39	924	.694
BMWS	T4	5.16	4.51	4.92	(4.69)	5.27	(4.42)	1.12	940	.263
Stressful life events in previous year	T4	1.52	(1.66)	2.27	(2.03)	1.15	(1.29)	-10.38	949	**<.001**

Note. t is the Student's t-test statistic, df is degrees of freedom. Boldface is significant at p = *.05.*

Prevalence of perinatal distress

Objective 2 of the current study was to report the prevalence of perinatal distress, in a convenience sample of women, in the third trimester of pregnancy, the first 8 weeks postpartum, and at 3 months postpartum. In the current study, perinatal distress included symptoms of depression, anxiety, worry and stressful life events.

Mood disturbance

More than one-third of women screened positive for depressive symptoms in the third trimester and significantly more Māori women than non-Māori women reported symptoms of both minor and major depression (see Table 19). The EPDS-3A was used to assess levels of anxiety. This scale has previously been validated as a brief measure of probable depression/anxiety using a cut-off of >9 (inflated score). The proportions of women who met this criterion are reported in Table 19. The proportions of women whose scores were >12 are also reported to allow comparison with the full EPDS scores and proportions. There were no significant differences in the prevalence of anxiety between Māori and non-Māori women in this study. Anxiety was most prevalent in the third trimester of pregnancy.

In line with depression and anxiety, levels of worry were higher in the third trimester than at 3 months postpartum. Using the BMWS, 12% were categorised as being high in worry and by 3 months postpartum this proportion has changed to 7%. Experiencing two or more stressful life events in the previous year has been associated with postpartum depression. Twice as many Māori women (61%) had experienced two or more stressful life events in the preceding 12 months than non-Māori women (30%), $\chi^2(1) = 84.21$, $p < .001$.

Table 19
Descriptive statistics for categorical perinatal distress related variables

Variable	Total %	% Māori (Lower-upper CI)		% non-Māori (Lower-upper CI)		χ^2	*p*
T2 EPDS >9	35.60	41.00	(35.58-46.65)	33.01	(29.45-36.79)	5.64	**.018**
T2 EPDS >12	16.50	20.33	(16.17-25.25)	14.67	(12.12-17.66)	4.71	**.030**
T4 EPDS >9	16.33	19.62	(15.62-24.35)	14.69	(12.15-17.66)	3.75	.053
T4 EPDS >12	7.80	9.49	(6.73-13.23)	6.95	(5.22-9.20)	1.90	.169
T2 EPDS-3A >9	68.93	73.00	67.71-77.71	66.99	63.21-70.55	3.15	.076
T2 EPDS-3A >12	52.86	57.33	51.68-62.80	50.72	46.81-54.61	3.30	.069
T3 EPDS-3A >9	44.10	45.70	40.17-51.33	43.32	39.47-47.24	0.37	.540
T3 EPDS-3A >12	28.49	29.14	24.30-34.50	28.18	24.78-31.84	0.05	.822
T4 EPDS-3A >9	46.68	45.89	40.47-51.40	47.08	43.22-50.97	0.08	.781
T4 EPDS-3A >12	28.56	30.70	25.87-35.99	27.49	24.15-31.09	0.91	.340
T2 BMWS>12	12.20	11.00	(7.94-15.05)	12.78	(10.39-15.62)	0.44	.504
T4 BMWS>12	7.22	7.69	(5.22-11.19)	6.98	(5.24-9.25)	0.07	.794

Note. χ^2 is the Pearson chi-squared statistic. Boldface is significant at p = *.05.*

Pattern of reporting depression

Of the 74 women who met the criteria for probable major depression at 3 months postpartum, 50% reported a prior history of mood disturbance (a period of two weeks or more of feeling particularly miserable or depressed), and 23% reported previous antenatal or postnatal depression. Half (49%) of these women met the same criteria (EPDS>12) in the third trimester of pregnancy, and half (51%) also met the same criteria, using the EPDS-3A, in the first 2 months postpartum.

Twenty-seven percent of women reported persistent symptoms of depression, meeting the criteria for probable major depression at all three time-points measured. There was also a group of women (18%) who met these criteria in the third trimester of pregnancy, and again at 3 months postpartum, but who reported non-clinical levels of depressive symptoms in the first 2 months postpartum.

The relationship of perinatal sleep to postnatal depression

The third objective of the E Moe, Māmā: Hauora Hinengaro study was to investigate the relationship of perinatal sleep with depressive symptoms at 3 months postpartum, after taking into account socio-demographic factors and known risk factors for postpartum depression.

Hierarchical, linear regression analyses, performed as ANCOVAs, using the SAS PROC GLM procedure, were used to determine the relationship between sleep factors and elevated levels of postnatal depression symptoms at three months postpartum, after controlling for demographic factors and a number of previously recognised risk factors for postnatal depression. Factors were grouped in blocks as shown in Table 20, with Block 3 variables separated into a number of different models depending on the facet of sleep of interest. For all of the following analyses, NZDep2006 data were collapsed into quintiles, as is common practice (Ministry of Health, 2006; Salmond et al., 2007). This has the effect of increasing the number of women in each quintile with the outcome of interest. The outcome of interest in this study was high scores on the EPDS.

Table 20
Table of variables used in postnatal depression linear regression models

Block	Grouping	Factor	Variable name
Block 1	Demographic factors		
		Ethnicity (Māori/non-Māori)	Ethnicity
		Maternal age	Maternal age
		Socioeconomic position	NZDep2006
Block 2	Recognised risk factors		
		Third trimester depression score	T2 EPDS
		Happiness in relationship with partner	T4 Partner relationship
		Number of stressful life events in the previous year	T4 Stressful life events
Block 3	Sleep related factors		
		Total sleep duration in 24-hours	T1 TST
			T2 TST
			T3 TST
			T4 TST
		Number of good night's sleep per week	T1 Good night's sleep
			T2 Good night's sleep
			T4 Good night's sleep
		GSDS Sleep onset subscale	T4 GSDS Sleep onset
		GSDS effect of sleepiness on daytime function subscale	T4 GSDS Sleepiness
		Snoring, nights per week	T1 Snoring
			T2 Snoring
			T3 Snoring
		Restless legs symptoms (Yes/No)	T2 Restless legs
			T4 Restless legs

Variance in postnatal depression symptoms

A series of multiple linear regressions (ANCOVA) were calculated to determine which variables independently contributed to the variance in postnatal depression symptom levels. Seven models were estimated and these focused on general sleep, sleep duration, percentage change in sleep duration, and sleep quality, percentage change in sleep quality, snoring and restless legs symptoms. Each model included three blocks of variables, which were entered sequentially. The variables in Block 1 (demographic factors) and Block 2 (recognised risk factors) remained constant for all models. Variables included in Block 3 changed for each of the seven models. In each of the seven models, variables in Block 1 are mutually adjusted for each other; variables in Block 2 are mutually adjusted for each other and for the variables in Block 1. Variables in Block 3 are mutually adjusted for all variables in Blocks 1, 2 and 3.

The variance explained by each block of variables is reported as eta squared (η^2), and the contribution added to the model by each successive block is reported as the change in η^2. The independent contribution of continuous variables is reported as partial eta squared (η^2_p). *Beta* values are the linear regression coefficients which quantify the increase or decrease in depression scores at 11–13 weeks postpartum (T4 EPDS) with each one unit increase in the level of the predictor variable. In the case of categorical variables, a reference category was set for each categorical variable against which the other levels of the variable were compared. Results of *post hoc* tests clarify which levels (if any) are significantly different from each other in terms of the sleep variables. These differences are reported as least squared means, with *p* values adjusted for multiple comparisons using Šidáks correction (Field & Miles, 2010).

General sleep model

Results of the general sleep model are shown in Table 21. The overall general sleep model explained 39% of the variance in postpartum depressive symptoms at three months postpartum. Demographic factors explained 1% of the variance in postpartum depression scores, η2 = 0.01, p = .12, and none of the three variables were significant predictors of depressive symptoms at 3 months postpartum.

Known risk factors explained 25% of the variance in postpartum depressive scores, $\eta^2 = 0.26$, $p < .001$, after controlling for demographic variables. Third trimester depression symptoms had a medium effect size, $\eta^2_p = 0.12$, and stressful life events had a small effect size, $\eta^2_p = 0.02$. Compared to women who reported feeling happy in their partner relationship (adjusted mean postpartum depression symptoms score = 5.25), those who felt neutral (adjusted mean 6.52, $p = .0008$) or unhappy (adjusted mean 6.45, $p = .01$) had

significantly higher depression scores at three months postpartum. Thirty-four women chose "not applicable" as their response option on this item. The mean EPDS score for women in that category (adjusted least squares mean 5.01, p = .99) did not differ significantly from women who reported feeling happy in their partner relationship.

General sleep items were entered into the model last and explained an additional 13% of the variance, η^2 = 0.39, p < .001. After controlling for demographic factors and previously recognised predictors of postnatal depression, difficulty falling asleep (GSDS sleep onset) and daytime sleepiness (GSDS daytime function) were both significantly related to postpartum depressive symptoms. In this model, higher postpartum EPDS scores are reported by women who have difficulty falling asleep and women whose daytime functioning is affected by sleepiness. GSDS sleep onset had a small effect, η^2_p = 0.05 and GSDS daytime function had a medium effect size, η^2_p = 0.07. Neither sleep duration at 3 months postpartum (T4 TST), nor the number of good night's sleep obtained per week (T4 GNS) were significantly related to postpartum depressive symptoms in the general sleep model.

In the general sleep model reported in Table 21, TST was entered as a continuous variable. The model was also run with sleep duration entered as a categorical variable where TST ≤6 hours was classified as short sleep duration, TST >6 to ≤9 hours was classified as average sleep duration and TST >9 hours was classified as long sleep duration. Categorising sleep in this way made no improvement to the model, η^2 = .38 compared to entering TST as a continuous variable, with 12% of the variance explained by general sleep variables in this iteration.

Table 21

General sleep model: associations of demographic factors, recognised risk factors, and general sleep variables with postnatal depression symptoms at 11–13 weeks postpartum

Variables	*Beta*	*t*	*p*	η^2_p	*[95% CI]*	η^2	*Change in η^2 from previous block*
Block 1							
Demographic						0.01	0.01
Ethnicity							
Non-Maori	Ref						
Maori	-0.108	-0.40	.689				
Maternal age	-0.001	-0.05	.962	0.009	[0.001-0.024]		
NZDep2006							
NZDep 1-2	Ref						
NZDep 3-4	-0.011	-0.04	.971				
NZDep 5-6	0.025	0.07	.940				
NZDep 7-8	-0.276	-0.74	.457				
NZDep 9-10	0.216	0.56	.576				
Block 2							
Recognised risk factors						0.26	0.25
T2 EPDS	0.281	10.96	**< .001**	0.122	[0.083-0.160]		
T4 Stressful life events	0.285	3.58	**< .001**	0.015	[0.003-0.034]		
T4 Partner relationship							
Happy	Ref						
Neutral	1.260	3.84	**< .001**				
Unhappy	1.197	3.06	**.002**				
Not applicable	-0.247	-0.38	.700				
Block 3							
General sleep variables						0.39	0.13
T4 TST	-0.090	-0.99	.323	0.001	[0.000-0.009]		
T4 Good night's sleep	-0.016	-0.26	.796	0.000	[0.000-0.005]		
T4 GSDS Sleep onset	0.477	6.59	**< .001**	0.048	[0.024-0.077]		
T4 GSDS Daytime function	0.700	7.87	**< .001**	0.067	[0.038-0.099]		

Note. *Effect size (η^2_p) is interpreted according to Cohen's guidelines of .01 = small effect size, .06 = medium effect size and .138 = large effect size. Boldface indicates significance at* p = *.05. Beta coefficients are the mean change in postnatal depression symptoms at 3 months postpartum, with higher scores meaning higher depression for a one unit increase in each explanatory variable. Variables in Block 1 are mutually adjusted for each other, variables in Block 2 are mutually adjusted for each other and for variables in Block 1 and variables in Block 3 are mutually adjusted for all variables in Blocks 1, 2, and 3.*

Specific sleep models

In order to more precisely explore the role of sleep in explaining symptoms of postpartum depression, total sleep duration, percentage change in sleep duration, sleep quality and percentage change in sleep quality were tested in four separate models. As the percentage of variance explained and significance values of demographic items and known risk factors were consistent in all models, those model statistics will not be repeated in the following results. Effect sizes (η^2_p) did vary and these are summarised in each of the following sections.

Model 2 – Sleep Duration

Results of the sleep duration model are reported in Table 22. The sleep duration block was built up in a sequential manner, so that only prior measures of TST were adjusted for, that is, T1 TST was analysed with no adjustment for other TST variables, then T2 TST was added while controlling for T1 TST and so on, until T4 TST was added while controlling for TST at the three previous time points. The addition of the sleep duration block into the model did not change the percentage of variance already explained by the demographic items and known risk factors, except for at T4. Overall, this sleep duration model explained 26 to 27% of the variance in postpartum depressive symptoms at three months postpartum.

Sleep duration at T3 and T4 were significantly associated with postpartum depressive symptoms. In late pregnancy and at three months postpartum, women who obtained more sleep at three months postpartum reported lower EPDS scores than women who obtained less sleep at that time. In the case of T4 TST, each one hour increase in sleep related to a 0.4 point decrease in EPDS scores. Sleep duration at T1 and T2 were not significantly associated with T4 EPDS scores. In these models T2 EPDS, stressful life events and partner relationship remained significant with no change in effect size except for T2 EPDS which became large for each of the four time points. T2 EPDS η^2_p ranged from 0.170 to 0.174.

Table 22.
Sleep duration model: associations of demographic factors, recognised risk factors, and total sleep duration variables with postnatal depression symptoms at 11–13 weeks postpartum

Variables	*Beta*	*t*	*p*	η^2_p	*[95% CI]*	η^2	*Change in η^2 from previous block*
Block 1							
Demographic						0.01	0.01
Block 2							
Recognised risk factors						0.26	0.25
Block 3							
Sleep duration							
T1 TST	-0.119	-1.03	.303	0.001	[0.000-0.009]	0.26	0.00
T2 TST	0.086	1.17	.242	0.002	[0.000-0.011]	0.26	0.00
T3 TST	-0.179	-2.41	**.016**	0.007	[0.006-0.021]	0.26	0.00
T4 TST	-0.390	-3.98	**< .001**	0.019	[0.005-0.040]	0.27	0.01

Note. *Effect size (η^2_p) is interpreted according to Cohen's guidelines of .01 = small effect size, .06 = medium effect size and .138 = large effect size. Boldface indicates significance at* p = *.05. Beta coefficients are the mean change in postnatal depression symptoms at 3 months postpartum, with higher scores meaning higher depression for a one unit increase in each explanatory variable. Variables in Block 1 are mutually adjusted for each other, variables in Block 2 are mutually adjusted for each other and for variables in Block 1 and variables in Block 3 are mutually adjusted for all variables in Blocks 1, 2, and 3.*

Change in sleep duration

Computationally, it was not possible to enter all change in sleep duration variables into the same model when the same time frame was captured in two variables, for instance, the linear relationship between T2–T4 was captured in a linear combination of T1–T2 and T1–T4. Instead the percentage change in sleep duration factors were entered into separate models. The final models explained between 26% to 28% of the variance in postpartum EPDS scores (see Table 23), with the Block 3 sleep change variables explaining between 0% to 2% of the variance.

Except for the change in TST from T1 to T2, changes in sleep duration were all significantly associated with postpartum depressive symptoms with the change from T2–T4 explaining the most variance. In all cases, this was a negative relationship, so that women who experienced a greater percentage decrease in TST scored higher on the EPDS at three months postpartum.

In these models, depression in late pregnancy (T2 EPDS), stressful life events and partner relationship remained significant with no change in effect size except for T2 EPDS which changed from medium to large for each of the four time points tested. T2 EPDS effect sizes (η^2_p) ranged from 0.168 to 0.177.

Table 23

Change in sleep duration model: associations of demographic factors, recognised risk factors, and percentage change in total sleep duration variables with postnatal depression symptoms at 11–13 weeks postpartum

Variables	*Beta*	*t*	*p*	η^2_p	*[95% CI]*	η^2	*Change in* η^2 *from previous block*
Block 1							
Demographic						0.01	0.01
Block 2							
Recognised risk factors						0.26	0.25
Block 3a[a]							
Percentage change in sleep duration							
TST T1 – T2	0.006	1.13	.260	0.001	[0.000-0.011]	0.26	0.00
TST T1 – T3	-0.011	-2.01	**.045**	0.005	[0.000-0.018]	0.26	0.00
TST T1 – T4	-0.025	-3.75	**<.001**	0.016	[0.004-0.036]	0.27	0.01
Block 3b[b]							
Percentage change in sleep duration							
TST T2 – T3	-0.015	-3.12	**.002**	0.011	[0.002-0.029]	0.27	0.01
TST T2 – T4	-0.027	-4.68	**<.001**	0.025	[0.008-0.048]	0.28	0.02
Block 3c[c]							
Percentage change in sleep duration							
TST T3 – T4	-0.023	-3.85	**<.001**	0.017	[0.004-0.038]	0.27	0.01

Note. *[a] Coefficients are adjusted for T1 TST as a baseline measure. [b] Coefficients are adjusted for T2 TST as a baseline measure. [c] Coefficients are adjusted for T3 TST as a baseline measure. Effect size (η^2p) is interpreted according to Cohen's guidelines of .01 = small effect size, .06 = medium effect size and .138 = large effect size. Boldface indicates significance at p = .05. Beta coefficients are the mean change in postnatal depression symptoms at 3 months postpartum, with higher scores meaning higher depression for a one unit increase in each explanatory variable. Variables in Block 1 are mutually adjusted for each other, variables in Block 2 are mutually adjusted for each other and for variables in Block 1 and variables in Block 3 are mutually adjusted for all variables in Blocks 1, 2, and 3.*

Sleep quality

Results of Model 4 are reported in Table 24. Overall, the sleep quality model explained 30% of the variance in the T4 EPDS scores. After controlling for demographic and recognised risk factors, and good night's sleep at T1 and T2, the good night's sleep at T4 explained an additional 4% of the variance. The number of good night's sleep women obtained prior to pregnancy and at 11–13 weeks postpartum was significantly associated with mood at 3 months postpartum so that fewer good night's sleep prior to pregnancy or at 11–13 week postpartum was related to increased EPDS scores (i.e. increased depression) at 11–13 weeks postpartum.

Table 24
Sleep quality model: associations of demographic factors, recognised risk factors, and sleep quality variables with postnatal depression symptoms at 11–13 weeks postpartum

Variables	*Beta*	*t*	*p*	η^2_p	*[CI]*	η^2	*Change in* η^2 *from previous block*
Block 1							
Demographic						0.01	0.01
Block 2							
Recognised risk factors						0.26	0.25
Block 3							
Good night's sleep per week (GNS)							
T1 GNS	-0.199	-2.35	**.019**	0.006	[0.000-0.020]	0.26	0.00
T2 GNS	0.037	0.53	.598	0.003	[0.000-0.007]	0.27	0.01
T4 GNS	-0.398	-7.00	**<.001**	0.053	[0.027-0.084]	0.30	0.04

Note. Effect size (η^2_p) is interpreted according to Cohen's guidelines of .01 = small effect size, .06 = medium effect size and .138 = large *effect* size. *Boldface indicates significance at* p = *.05. Beta coefficients are the mean change in postnatal depression symptoms at 3 months postpartum, with higher scores meaning higher depression for a one unit increase in each explanatory variable. Variables in Block 1 are mutually adjusted for each other, variables in Block 2 are mutually adjusted for each other and for variables in Block 1 and variables in Block 3 are mutually adjusted for all variables in Blocks 1, 2, and 3.*

In the sleep quality models depression in late pregnancy (T2 EPDS), stressful life events and partner relationship remained significant with no change in effect size except for depression in late pregnancy (T2 EPDS) which changed from medium to large for each of the four time points. T2 EPDS effect sizes (η^2_p) ranged from 0.160 to 0.163.

Change in sleep quality

As in the change in sleep duration model, Block 3 change in good night's sleep were all entered into separate models. Good night's sleep were not measured at T3. Change in sleep quality explained between 27% to 30% of the total variance in symptoms of depression at 3 months postpartum (see Table 25). Change in sleep quality from T1 to T4 and T2 to T4 were significantly associated with postpartum depressive symptoms, and the direction of these associations was congruent with those seen for change in sleep duration. A greater percentage decrease in the number of good night's sleep obtained per week was related to an increase in EPDS scores at 3 months postpartum.

Table 25
Change in sleep quality model: associations of demographic factors, recognised risk factors, and percentage change in sleep quality variables with postnatal depression symptoms at 11–13 weeks postpartum

Variables	*Beta*	*t*	*p*	η^2_p	*[CI]*	η^2	*Change in* η^2 *from previous block*
Block 1							
Demographic						0.01	0.01
Block 2							
Recognised risk factors						0.26	0.25
Block 3a[a]							
Percentage change in good night's sleep per week (GNS)							
GNS T1 – T2	0.002	0.81	.420	0.001	[0.000-0.009]	0.27	0.01
GNS T1 – T4	-0.013	-5.75	**<.001**	0.037	[0.016-0.064]	0.30	0.04
Block 3b[b]							
Percentage change in good night's sleep per week (GNS)							
GNS T2 – T4	-0.006	-5.35	**<.001**	0.038	[0.015-0.068]	0.29	0.03

Note. [a] *Coefficients are adjusted for T1 GNS as a baseline measure.* [b] *Coefficient is adjusted for T2 GNS as a baseline measure.* Effect size (η^2_p) is interpreted according to Cohen's guidelines of .01 = small effect size, .06 = medium effect size and .138 = large *effect* size. *Boldface indicates significance at* p = *.05. Beta coefficients are the mean change in postnatal depression symptoms at 3 months postpartum, with higher scores meaning higher depression for a one unit increase in each explanatory variable. Variables in Block 1 are mutually adjusted for each other, variables in Block 2 are mutually adjusted for each other and for variables in Block 1 and variables in Block 3 are mutually adjusted for all variables in Blocks 1, 2, and 3.*

In the sleep quality models depression in late pregnancy (T2 EPDS), stressful life events and partner relationship remained significant with no change in effect size except for T2 EPDS which changed from medium to large for each of the four time points. T2 EPDS effect sizes (η^2_p) ranged from 0.164 to 0.168.

Snoring

Table 26
Snoring model: associations of demographic factors, recognised risk factors, and snoring variables with postnatal depression symptoms at 11–13 weeks postpartum

Variables	*Beta*	*t*	*p*	η^2_p	*[CI]*	η^2	*Change in η^2 from previous block*
Block 1							
Demographic						0.01	0.01
Block 2							
Recognised risk factors						0.26	0.25
Block 3							
Snoring T1	0.048	0.58	0.56	0.000	[0.000-0.007]	0.27	0.01
Snoring T2	-0.010	-0.17	0.86	0.000	[0.000-0.004]	0.27	0.01
Snoring T4	0.061	0.51	0.61	0.000	[0.000-0.007]	0.26	0.00

Note. Effect size (η^2_p) is interpreted according to Cohen's guidelines of .01 = small effect size, .06 = medium effect size and .138 = large *effect* size. *Boldface indicates significance at* p = *.05. Beta coefficients are the mean change in postnatal depression symptoms at 3 months postpartum, with higher scores meaning higher depression for a one unit increase in each explanatory variable. Variables in Block 1 are mutually adjusted for each other, variables in Block 2 are mutually adjusted for each other and for variables in Block 1 and variables in Block 3 are mutually adjusted for all variables in Blocks 1, 2, and 3.*

Snoring at any time point was not associated with postpartum depression (see Table 26). In the snoring models T2 EPDS, stressful life events and partner relationship remained significant with no change in effect size except for T2 EPDS which became large for each of the four time points. T2 EPDS effect sizes (η^2_p) ranged from 0.166 to 0.220.

Experiencing restless legs during pregnancy was not associated with postpartum depression (see Table 27). Experiencing restless legs at 3 months postpartum was independently associated with depressive symptoms at the same time. In the restless legs models T2 EPDS, stressful life events and partner relationship remained significant with no change in effect size except for T2 EPDS which became large for each of the four time points. T2 EPDS effect sizes (η^2_p) ranged from 0.168 at T2 and 0.161.

Restless Legs

Table 27

Restless legs model: associations of demographic factors, recognised risk factors, and restless legs variables with postnatal depression symptoms at 11–13 weeks postpartum

Variables	*Beta*	*t*	*p*	η^2_p	*[CI]*	η^2	*Change in* η^2 *from previous block*
Block 1							
Demographic						0.01	0.01
Block 2							
Recognised risk factors						0.26	0.25
Block 3							
RLS T2	0.30	0.91	0.36	0.000	[0.000-0.009]	0.26	0.00
RLS T4	1.08	2.01	**0.05**	0.005	[0.000-0.017]	0.26	0.00

Note. Effect size (η^2_p) is interpreted according to Cohen's guidelines of .01 = small effect size, .06 = medium effect size and .138 = large *effect* size. *Boldface indicates significance at* p = *.05. Beta coefficients are the mean change in postnatal depression symptoms at 3 months postpartum, with higher scores meaning higher depression for a one unit increase in each explanatory variable. Variables in Block 1 are mutually adjusted for each other, variables in Block 2 are mutually adjusted for each other and for variables in Block 1 and variables in Block 3 are mutually adjusted for all variables in Blocks 1, 2, and 3.*

Chapter Four

Study One—E Moe, Māmā: Hauora Hinengaro Discussion

Overview of findings

The overall aim of this study was to investigate the relationship between perinatal changes in sleep duration and quality and the association with maternal mood at 3 months postpartum. This was achieved by collecting comprehensive data using written postal and telephone surveys during pregnancy and in the first 11–13 weeks after birth.

Specifically, the objectives of Study One were: to investigate the change in sleep and mood across the perinatal period in New Zealand women; to determine the prevalence in a convenience sample of women with perinatal distress (including stressful life events, worry, anxiety and postnatal depression) in the third trimester of pregnancy, in the first 8 weeks postpartum and at 3 months postpartum; and to investigate the relationship of perinatal sleep with depressive symptoms at 3 months postpartum. The findings presented here represent the most comprehensive description to date of sleep and mood in New Zealand Māori and non-Māori women during the perinatal year.

It was hypothesised that women who experienced greater change in their usual sleep quantity or quality would be at greater risk of depression. Although the greatest change in sleep duration was from prior to pregnancy (T1) to the third trimester (T2), this was not found to be associated with higher levels of postpartum depression. Changes in sleep duration and sleep quality, from any previous time point to either 2 or 3 months postpartum, were found to be independently associated with higher levels of depression at 3 months postpartum.

Importantly, this study found that a *continued* decline in sleep quality and quantity across the perinatal year was associated with higher levels of depression at 3 months postpartum. Further, and novel to this study, was the finding that the *magnitude* or percentage changes in sleep quantity and sleep quality were also associated with higher levels of postpartum depression. These relationships were found to be significant in all analytic models when the terminal time point was in the postpartum period (i.e. changes from any of T1, T2 or T3 to T3 or T4), but not when the terminal time point was the third

trimester (i.e. changes from T1 to T2). While others have reported on the role of historical sleep problems in perinatal mood disorders (e.g. Dorheim et al., 2009a), changes in sleep patterns between weekday nights and weekend nights and perinatal depressive symptoms (e.g. Wolfson et al., 2003) and changes in sleep quality in relation to the recurrence of depression in the postpartum period (Okun, Luther, et al., 2011), it is believed that this is the first study to identify relationships between postpartum depressive symptomology and the absolute value of longitudinal changes in sleep quantity or quality as well the magnitude or percentage changes in sleep quantity or quality.

Unexpectedly, no relationship was found between ethnicity, maternal age and socio-economic position and mood at 3 months postpartum. Three previously recognised risk factors (depression in pregnancy, stressful life events and relationship happiness as a proxy of social support) were, as expected, all significantly related to postpartum depression, with antenatal depression exerting the strongest effect of any factor investigated in this study. This is consistent with previous research on risk factors for postpartum depression (Robertson et al., 2004) and indicates the need for identification of depression in pregnancy. Screening and assessment may even begin prior to conception if a woman is known to be planning for pregnancy.

The remainder of this chapter is divided into separate sections relating to each of the three objectives of the E Moe, Māmā: Hauora Hinengaro study. The chapter concludes with a discussion of limitations and strengths of the study.

Objective 1

The first objective of the E Moe, Māmā: Hauora Hinengaro study was to investigate the change in sleep and mood across the perinatal period in New Zealand women.

The experiences of pregnancy and parenting in the first 3 months postpartum did impact both the amount of sleep women obtained in 24 hours and the quality of their sleep. Self-reported sleep duration and sleep quality followed the same pattern as each other across the course of this study. Both the quantity and quality of sleep obtained by women were highest prior to pregnancy, lowest in the third trimester of pregnancy, and although higher than in pregnancy, neither had returned to pre-pregnant baseline levels by 3 months postpartum.

Mood was assessed using a range of measures in late pregnancy and at 3 months postpartum and followed the same pattern as sleep change. Mood was poorest on all measures in late pregnancy, with an overall improvement in mood on all measures by 3 months postpartum.

Participant characteristics

The current sample of 951 women (33% Māori and 67% non-Māori) were on average 29 years of age and 31 years of age respectively. The distribution of area deprivation rankings (NZDep2006) followed that seen in prior research with Māori over-represented in the areas of highest deprivation, and non-Māori over-represented in the areas of lowest deprivation (Paine & Gander, 2013; Salmond & Crampton, 2012). However, this factor did not exert a significant effect on postnatal depression in any of the regression models. Although health and other social outcomes are strongly linked to NZDep rankings, use of this small area measure of deprivation as the sole proxy for socio-economic position is not without limitations (Blakely, 2002). For instance, in the current study, NZDep2006 may not have been sensitive to the changes in the economic status of women as they moved in and out of the paid workforce, which is concomitant with this particular phase of life. In future studies that consider the relationship between socioeconomic position and maternal mental health, it is suggested that a combination of socio-economic measures, for example NZDep, the New Zealand Index of Socioeconomic Deprivation for Individuals (NZiDep; Capital and Coast District Health Board, 2012), years of education, and combined household income and/or other individually based measures, may offer greater sensitivity to detect the expected and established relationships seen in the general population.

Half of the women were having their first baby and most infants were born in a hospital or community maternity facility. In this sample 4.5% of women gave birth at home, which is slightly higher than the national rate of 3.2% (Ministry of Health, 2012b). Non-Māori women were more likely than Māori to have been trying to get pregnant, and to have used artificial reproductive technologies to become pregnant. They were also more likely to have received epidural anaesthesia and/or an emergency caesarean section at delivery. There were no differences by ethnicity in the rates of induction of labour, instrumental delivery, general anaesthesia or planned caesarean section. In general, these rates are comparable to national averages with two exceptions. Epidural rates were higher (41.5%) than the national rate (24.9%), but general anaesthesia rates for caesarean section appear to be lower in this study (2.6%) than the national rate (9%). It is not known why the rate of general anaesthesia differed so much from the national rates. With regard to the epidural rate, a large number of women participating in this study were located within Wellington and gave birth at the regional maternity facility. This facility has traditionally had one of the highest epidural rates in the country (Capital and Coast District Health Board, 2004; Nelson, 2006). In 2012 the rate for labour related neuraxial

blocks was 58% (Capital and Coast District Health Board, 2012). This may explain, at least in part, some of this discrepancy.

At 3 months postpartum Māori mothers were more likely than non-Māori mothers to have their infant sleep in the parental bedroom, either in the parental bed or in a separate sleeping space. They were also less likely to report their infant's sleep to be a problem and less likely to be exclusively breastfeeding their infant. Current recommendations for the prevention of the sudden unexpected death of an infant (SUDI) include that infants sleep in their own sleep space and that mothers are encouraged to breastfeed. Breastfeeding is reported to be enhanced when infants sleep in close proximity to their mothers, either in the maternal bed or close by (McKenna & McDade, 2005). However, this relationship between room/bed sharing and breastfeeding was not evident in this sample of Māori women. Safe infant sleep research is underway in New Zealand with a particular focus on Māori families such as through wahakura (flax infant sleeping basket) projects (Abel & Tipene-Leach, 2013) as well safe sleep education and SUDI prevention in the general population (Galland, Sayers, et al., 2012). Barriers to breastfeeding have also been identified by Māori, including a lack of clear, comprehensible information about breastfeeding, co-sleeping and maternal smoking when breastfeeding (Glover, Waldon, Manaena-Biddle, Holdaway, & Cunningham, 2009). Findings from the current study relating to breastfeeding and co-sleeping rates support the need to continue research, education and intervention in these areas.

Sleep duration

During the course of this study, all but a few women (1%) experienced a change from their usual pre-pregnant amount of sleep in 24 hours compared to their usual sleep in pregnancy, the postpartum period or both. Overall, mean sleep duration was 8.2 hours prior to pregnancy, which is higher than women in the general population who were previously surveyed as having a mean sleep duration of 7.8 hours (Signal et al., 2013). Hutchison et al. (2012) conducted a postal survey of 244 women in Auckland, New Zealand, in the third trimester of pregnancy. Average sleep duration prior to pregnancy was 8.1 hours. Hedman et al. (2002) retrospectively measured pre-pregnant sleep as soon as pregnancy was verified, at an initial antenatal check-up. They reported usual pre-pregnant sleep duration of 8 hours which is not dissimilar to that reported in the current study. A limitation of all of these studies is the use of retrospective reports of sleep duration prior to pregnancy and it is recognised that this method may be subject to recall bias. Lee et al. (2000) conducted one of the only prospective studies of sleep from prior to conception to the postpartum period in American women. Using polysomnography, they

reported pre-pregnant sleep duration of 6.8 hours. There has been one published report comparing prospective self-reported sleep duration with objectively measured sleep duration using PSG in pregnant women (Wilson, Fung, Walker, & Barnes, 2012). Women in that study tended to incorrectly report sleep duration in the third trimester, compared to PSG measure sleep duration. On average this was in the order of minutes, and the difference was not reported to be statistically significant. In that study there was wide variation in both over- and under-reporting of sleep duration.

In the present study, by the third trimester of pregnancy, sleep duration had reduced on average by 54 minutes to 7.3 hours. Third trimester sleep duration in the Hutchison et al. (2012) study was 7.5 hours (prospectively measured). In the Lee et al. (2000) study PSG measured sleep duration was 6.9 hours while in the Hedman et al. (2002) study, prospectively self-reported, third trimester sleep duration was much higher at 8.3 hours. The effects of sleep loss have been demonstrated to accumulate over time (e.g. Van Dongen, Maislin, et al., 2003) and in the present study would result in approximately 7 hours of sleep loss per week (although the limitations of the retrospective report of sleep prior to pregnancy are acknowledged). During pregnancy women may have opportunities to catch up on sleep at weekends, when they are less likely to be working outside of the home, or when partners or other family members are more available to assist with childcare, allowing women to sleep in later in the morning or nap during the day. Once they have given birth though opportunities for sleep will be reduced because of around the clock infant care.

By 3 months postpartum, usual sleep duration was 7.5 hours, representing a 42 minute shortfall compared to usual, non-pregnant sleep. This amount was similar to previous studies; for example, Hedman et al., (2002) reported sleep duration at 3 months postpartum to be 7.4 hours, while Dorheim et al. (2009b) reported sleep duration of 7.3 hours in non-depressed postpartum women. Montgomery-Downs et al. (2010) reported sleep duration for non-depressed women whose infants were between 2–16 weeks of age and found it to be stable at 7.2 hours across this time. Although sleep duration increased slightly by 3 months postpartum in the E Moe, Māmā: Hauora Hinengaro sample, usual sleep duration had not returned to baseline pre-pregnant levels. This could indicate that sleep deprivation had become chronic by 3 months postpartum, having started during pregnancy for many women. As yet, it is not known how long it takes for women to meet their usual requirement for sleep after pregnancy, birth and the early postpartum period of intense infant care.

Although the pattern of change in perinatal sleep duration across time is similar to previous reports findings in the current study differ in one important aspect. Sleep

duration was at the lowest level in the third trimester, whereas Lee at al. (2000) and Signal et al. (2007) reported sleep duration to be lowest in the first month postpartum. Both of those studies measured sleep objectively using either PSG or actigraphy and this highlights both the challenge of comparing findings which have used different methods of measurement and the need to replicate the few studies which have objectively measured sleep in perinatal women.

The pattern seen in the current study also differed from that reported by Hedman et al. (2002). They surveyed 325 women in Finland at the start of pregnancy and in the first 3 months postpartum. In contrast to the current study, average sleep duration in 24 hours *increased* from prior to pregnancy (8 hours) to the third trimester (8.3 hours) after which it fell significantly by almost 1 hour from the last trimester to 3 months postpartum (7.4 hours). The observation that sleep increased from before pregnancy to the third trimester of that study may be related to inaccuracies in retrospectively reporting sleep duration prior to pregnancy. It may also be related to Finland's paid maternity leave policy. Women are actively encouraged to commence leave 50–30 working days *before* the estimated date of delivery (Kela, 2013). This would allow increased prenatal opportunities for sleep and napping. Policies such as these indicate the importance of protected time for sleep in late pregnancy. There are currently no requirements or guidelines specifying when a woman should begin maternity leave in New Zealand. Anecdotally, women report that the decision about the timing of their maternity leave is more influenced by economics and/or completion of work assignments than being able to take time to rest and prepare for childbirth and parenting.

Anecdotal reports from women also indicate that their concerns about sleep in pregnancy are often minimalised, yet this study demonstrates that perinatal sleep duration is at its lowest before the infant is born. Laboratory induced decreases in sleep duration have been associated with alterations in normal physiologic functioning, such as glucose metabolism (Spiegel et al., 2009), neurobehavioural performance (Van Dongen, Maislin, et al., 2003) and mood (Pilcher & Huffcutt, 1996). Even modest restrictions to sleep duration, such as reducing usual sleep from 8 hours to 6 hours per night, have produced negative physiologic (increased inflammatory response) and neurocognitive (increased sleepiness and decreased performance) changes (Vgontzas et al., 2004). This level of sleep restriction was common in the current study. In the third trimester, 42% of women reported sleep reduction of greater than 1 hour per night and at 3 months postpartum 12% of women reported the same reduction.

Shortened sleep duration in perinatal women has also been linked with impaired glucose metabolism (Facco, Grobman, Kramer, Ho, & Zee, 2011), neurobehavioural

performance (Insana et al., 2013) and poor mood, including new onset depression (Ross, Murray, & Steiner, 2005). The finding that mood was low in the third trimester in this study is therefore consistent with limited previous studies in pregnancy samples.

As Van Dongen et al. (2003) have described, accumulated sleep loss can lead to neurobehavioural performance deficits even though the individual may not perceive similar levels of increasing sleepiness. Restricted sleep may interfere with a mother's ability to adapt to her new role (Kennedy et al., 2007), especially if her mood, motivation, information processing capacity and learning and memory are negatively affected. Moreover, neurobehavioural changes due to insufficient sleep duration put her at increased risk of accidents, including driving related accidents.

While most women reported decreases in usual sleep in the current study, particularly in late pregnancy and at 3 months postpartum, increased sleep duration was also common. In late pregnancy 23% of women reported an increase from usual, non-pregnant sleep duration, and at 3 months postpartum 26% reported an increase from usual sleep duration. Extremes of sleep duration have been associated with increased morbidity and mortality in the general population (Grandner & Drummond, 2007; Grandner et al., 2010) and both hyposomnia and hypersomnia are associated with mood disorders such as depression.

Usual non-pregnant sleep durations for Māori women were significantly longer than non-Māori women. This was also true at 3 months postpartum, when 13.9% of Māori women were classified as long sleepers (greater than 9 hours) compared to 3.8% of non-Māori women. In the general population, the prevalence of both short and long sleepers is higher in Māori than non-Māori samples (Paine & Gander, 2013). The difference seen in the present study may be due, at least in part, to the difference in the distribution of age in these studies. Māori women in this study were more likely to be under 25 years of age than non-Māori women, and normal age related changes in sleep duration mean that long sleep is more likely to be the norm in participants under 25 years of age (Ohayon, Carskadon, Guilleminault, & Vitello, 2004). There may also be differences in other socioeconomic or health related variables between Māori and non-Māori that have not been captured in this study but which have the potential to impact sleep duration. Māori women are possibly at greater risk of adverse effects from abnormal sleep duration. Although a small amount of literature is emerging regarding insufficient sleep and negative outcomes in perinatal women (Facco et al., 2011; Qiu et al., 2010), the high prevalence of long sleep in the present study points to the need for the consequences to be investigated in perinatal women.

Sleep quality

Subjective sleep quality is usually determined from a range of measures including total sleep time, sleep onset latency, sleep fragmentation, time spent awake, sleep efficiency, and number and type of events interrupting sleep. Sleep fragmentation refers to any disturbance to the continuity of a sleep period. Consistent with previous reports, a range of factors contributed to sleep fragmentation during pregnancy and at 3 months postpartum. The top three factors reported by women as disturbing antenatal sleep were nocturnal urinary frequency (90%), not being able to get comfortable (68%) and back, neck or joint pain (66%).

At 3 months postpartum, more than 80% of infants were waking at least once per night and mothers were frequently attending to infants when they woke, with 75% reporting waking to feed their infant in the night and 20% reporting waking to carry out other infant care during the night. While attending to infant essential needs was the main cause of sleep disruption at 3 months postpartum, women were also disturbed by a range of other factors including going to the bathroom, pain or discomfort and an inability to fall asleep. It was noted in this study that sleep was affected in a small number of women, either because they experienced earthquakes, or because they were worrying about earthquakes, after the catastrophic earthquakes in Christchurch on 4 September 2010 and 22 February 2011. These women did not necessarily live in Christchurch but were nonetheless psychologically affected by these events.

Pathological conditions and symptoms associated with pregnancy and birth may also impact postpartum sleep, such as pain, anaemia and incontinence. At 3 months postpartum a number of women were still affected by birth related pain (3%). Both acute and chronic pain can negatively impact sleep quality (Lavigne, Smith, Denis, & Zucconi, 2011) and, conversely, poor sleep quality has been associated with lowered pain thresholds leading to an increase in pain perception (Haack & Mullington, 2005). Providing perinatal women with strategies to improve pain management and/or sleep quality have the potential to improve postnatal wellbeing and women should be encouraged to raise this with their health professional.

At 3 months postpartum, Māori women were significantly more likely to be receiving treatment or monitoring for anaemia (14.6%) than non-Māori women (10%). Iron deficiency has been implicated as one of a number of contributing factors to restless legs syndrome which in turn disturbs sleep (Manconi et al., 2012). As with the other proportions reported for pathological conditions and symptoms, these figures represent only the women who were being monitored or treated. The true proportions of women with these symptoms are likely to be higher. On average, 12% of New Zealand females

aged 16 to 44 years are low in stores of iron, 6% are iron deficient with anaemia and no difference has been reported between Māori and non-Māori women (Ministry of Health, 2012a). It is not surprising that the rate of women being treated for anaemia in the current study is higher than that observed in the general population. Iron intakes in pregnancy must match normal requirements as well as the requirements of the foetus and increased maternal blood volume (Ministry of Health., 2006). However, further investigation of the disparity in rates of anaemia between Māori and non-Māori found in the current study is warranted.

Another 2.3% of women reported being treated for either faecal or urinary incontinence. It was somewhat surprising that the proportion of women being treated for faecal incontinence (1.1%) was almost the same as for urinary incontinence (1.2%). Faecal incontinence is seldom discussed openly in childbirth education or perinatal care settings, unlike urinary incontinence and pelvic floor muscle care. This suggests a number of women are likely to be suffering in silence, both in terms of managing incontinence, the stigma associated with the disorder and the implications for sleep when bowel or bladder control are poor. Similar rates were reported in a study of postpartum French women at 5 months postpartum (Saurel-Cubizolles, Romito, Lelong, & Ancel, 2000) with considerably higher rates for Italian women reported in the same study. A concerning finding in that study was that the rates of incontinence in both groups increased significantly, doubling and in some cases tripling, by 12 months postpartum. The authors suggested that women may under-report symptoms earlier in the postpartum year, perhaps perceiving them to be a 'normal' part of the recovery from childbirth.

In a New Zealand study of 1,505 perinatal women, 34% reported some postpartum urinary incontinence (Wilson, Herbison, & Herbison, 1996). Our question asked only if women were being monitored or treated for incontinence, not if they experienced *any* incontinence. Potentially large numbers of women are putting up with this distressing condition and the possible impact it may have on sleep. No literature could be found investigating the impact of incontinence on sleep in perinatal women. However, a prospective, general population study which surveyed 2,535 women at baseline, with follow-up five years later, found that the chance of urological symptoms (including incontinence) developing was consistently higher for individuals who also reported poor sleep quality and sleep restriction (5 hours or less per night) at baseline (Araujo et al., in press). This suggests at least some interaction between incontinence and sleep and the dearth of literature about this issue in perinatal women commands attention.

In the present study, sleep quality was also measured in late pregnancy and at 3 months postpartum using a general measure of sleep disturbance (the GSDS) and by

asking women about the number of good night's sleep they obtained per week. Using these measures, sleep quality was poorest in late pregnancy compared to any other time point measured. Mean scores on the GSDS subscales were dichotomised, with a cutoff of three or more indicating meaningful levels of sleep disturbance. Of all the GSDS subscales, at all the time points, the sleep maintenance subscale in the third trimester of pregnancy yielded the poorest scores with women affected on an average of 6.3 nights per week. This reflects, at least in part, the previously discussed disturbance from factors such as night time bathroom visits, pain, and discomfort. Although antenatal mean scores were above three on all but one of the GSDS subscales (sleep onset), by 3 months postpartum sleep maintenance was the only subscale to remain above this threshold. Māori women were more likely to report difficulty with sleep onset and non-Māori women were more likely to report difficulty staying asleep.

A small body of evidence is emerging regarding the relationship between snoring and restless legs syndrome and depression during pregnancy (O'Brien, Owusu, et al., 2013) . In the current study, snoring was not found to be independently associated with postpartum depressive symptoms, after controlling for socioeconomic factors and previously recognised risk factors. It is possible that pregnancy specific mechanisms, such as weight gain and alterations in fluid volumes, interact to produce the effect seen by O'Brien et al., and that these resolve after birth.

In the current study, there was no relationship between symptoms of restless legs syndrome in the third trimester and depressive symptoms at 3 months postpartum. However, there was a significant association between restless legs symptoms at 3 months postpartum and depressive symptoms at that time. Restless legs syndrome is a common occurrence in pregnancy for up to 30% of women and most women experience a spontaneous reduction of symptoms immediately after birth (Manconi et al., 2012). Given that the proportion of women reporting symptoms of restless legs halved from the third trimester to 3 months postpartum, it appears that women who *continued* to experience restless legs syndrome after birth were more at risk of depressive symptoms. Low iron stores may be a contributing factor to restless legs syndrome and a number of women reported that they were being treated for postpartum anaemia. Women who continue to experience restless legs symptoms into the postpartum should be evaluated for iron deficiency. This could provide a simple, low cost intervention for symptoms which are distressing in their own right, but which may also have a relationship to poor mood.

Over the course of a 24 hour day, the majority of postpartum women in the present study were be able to obtain sleep in the 7–9 hour range considered essential for healthy function. Average total sleep time did not fall below 7 hours at any time point in the

current study and in this way sleep quantity was preserved for 72% of women. However, high levels of sleep cycle fragmentation were identified through measures including the number of times infants woke during the night and the number of nights disturbed by other factors. The degree of sleep fragmentation experienced by women in this study was most clearly illustrated by high scores on the GSDS sleep maintenance subscale, which remained at a significantly poor level from the prenatal to postnatal period. Fragmentation affects sleep architecture so that women would have experienced frequent interruptions to the sleep cycles normally seen in long, consolidated blocks of sleep. Sleep fragmentation has been shown to diminish the restorative power of sleep with negative consequences akin to those seen after total sleep deprivation (Bonnet, 2011). It could be expected, that given the level of sleep disruption seen in this study, sleep pressure would be high. Therefore, the issue of sleep quality is equally as important as how much sleep is obtained by postpartum women.

Broadly speaking, the structure of sleep is governed by two processes: the first being the sleep homeostat or pressure for sleep. This is driven by the effects of being awake (either through continuous waking as happens in a 'normal' day, or through the cumulative effects of sleep loss or disruption); and the second being the circadian biological clock. Deep, slow wave sleep is most prevalent in the first half of the night and is preserved at the expense of other stages of sleep (including other stages of nREM and REM) until it has been sufficiently recovered (Banks & Dinges, 2011). REM sleep is influenced by the circadian clock and is timed to occur mostly in the later part of the night. Given an opportunity for sleep recovery, slow wave sleep is likely to be recovered first, and if the sleep episode is curtailed, for instance to attend to an infant, the opportunity to obtain REM is minimised. Depending on the timing of a sleep period, or the amount of fragmentation to sleep, REM sleep may further be comprised. Disruptions to sleep in the later part of the night reduce the opportunity for REM sleep. Together, the full benefits of continuous, optimally timed sleep cycles are not realised, and in this way sleep quality is compromised. The net result may then be increased daytime sleepiness, poorer neurobehavioural functioning, and possibly a perception of unrefreshing sleep, despite having obtained what seems like an individual's 'normal' amount of sleep in 24-hours.

Alterations to the timing and deprivation of REM sleep have been associated with a reduced capacity to process the emotional content of memories (Germain, 2013; Groch et al., 2013) and this has been proposed as one of the mechanisms in the maintenance of symptoms of post-traumatic stress disorder (Germain & Kupfer, 2008). Little is known about the architectural structure of perinatal sleep, or potential changes to structure at

this time. Further research is called for and this could potentially elucidate some of the biological mechanisms involved in the onset of perinatal mood disorders.

Prior history of mood disturbance

One third of women in this non-clinical, community sample reported having experienced symptoms of mood disturbance (i.e. had a period of two weeks or more when they felt particularly miserable or depressed) prior to pregnancy. One quarter of women had previously been diagnosed with depression (i.e. told by a health professional that they had depression or needed antidepressants). Non-Māori women were more likely to report previous symptoms than Māori, but there was no difference by ethnicity in the proportions of women who had previously received a diagnosis of depression. The lifetime prevalence for mood disorders in women in New Zealand is equal to that seen in the E Moe, Māmā: Hauora Hinengaro study. However, contrary to the prevalence in the general population, prior mood history was more common in non-Māori than Māori women in this sample (Ministry of Health, 2006). The opposite was true for prior history of antenatal or postnatal depression. In that case, twice as many Māori women reported previous perinatal depression (15.5%) as non-Māori women (7.5%).

While a single episode of depression may be an acute, time-limited illness with no further occurrence, for many people the risk of recurrence is high (Monroe & Harkness, 2011). Between 35–50% of individuals with a major depressive disorder experience a recurrence (Eaton et al., 2008), including women with a prior history who experience recurrence in pregnancy (Cohen et al., 2006). Banti et al. (2011) investigated the incidence, prevalence, recurrence and new onset of depression in a population of 1,066 perinatal women. They estimated the relative risk of developing minor or major depression during the perinatal period to be two-fold in women who had a prior history of depression. Seventy-four women in the current study reported symptoms of major depression in the postnatal period using the EPDS and 50% of those women also reported a prior history of mood disturbance and 43% had previously been diagnosed as having depression. Historically, there has been no policy in New Zealand to ensure perinatal women are routinely or systematically screened for mood disorders (Barber, 2009). For the first time, guidelines on this topic were published by the Ministry of Health in 2011 in the *Healthy Beginnings: Developing perinatal and infant mental health services in New Zealand* report (Ministry of Health, 2011a). The report recognises the gaps and piecemeal provision of services to date, and signals an intention to rectify this but also states that this will happen within the restraints of time, funding and planning. The findings in the current study reinforce the need for these service improvements.

Whilst some concern has been expressed about the possibility of 'overpathologising motherhood' (Matthey, 2010), the risk of not carefully screening for symptoms of mood disorders throughout the perinatal year is that opportunities may be missed for early intervention and treatment. Women tolerate a high degree of physical health surveillance during the perinatal period in the form of a growing list of screens and diagnostic tests related to their own or their infant's health (see www.health.govt.nz, *Pregnancy and Newborn Screening* for examples). Given the potential consequences for women and their families, mental health screening should receive similar prioritisation.

In a separate question, 23% of women in the study reported having previously had antenatal or postnatal depression. Since half of the women in the study were having their first baby, the proportion of women reporting prior antenatal or postnatal depression represents half of the women who were already mothers (including a small number who may have experienced perinatal loss).

Help seeking

Women were also asked if they had sought professional help for mood disturbance prior to pregnancy and 63% reported doing so. However, women who reported mood disturbance in the current pregnancy were less likely to seek help. One study investigating barriers to treatment for perinatal depression reported that around half of women turned to friends and family for help compared to the 12% who sought professional help, even though the women reported having the highest levels of confidence in professional sources of help (O'Mahen & Flynn, 2008). In that study, structural barriers were reported as the main problem in seeking help including the inability to pay for treatment, as well as difficulties with access to transport and childcare options. Mothers also reported being unsure who to contact for help, lack of motivation to seek treatment and hopelessness about treatment being successful. Thio et al. (2006) also reported that only 13% of women with depressive symptoms were being treated in a sample of 225 European New Zealand women.

As well as being distressing for the women experiencing this mood disorder, postnatal depression has been shown to compromise maternal-infant interactions and attachment relationships, partner relationships and the likelihood of breastfeeding. With each episode of major depression women become at increased risk of a subsequent episode and may be at increased risk of self-harm.

Untreated postnatal depression also has implications for infant health. For example, Minkovitz et al. (2005) found that mothers with depressive symptoms at 2–4 months

postpartum were less likely to access preventive services including well-child visits and immunisations in their infant's first year, and were subsequently more likely to attend for acute care and emergency department visits in later infancy (30–33 months). In terms of psychological health, the Avon Longitudinal Study of Parents and Children (ALSPAC), which has over 7,000 participants, has linked prenatal anxiety and postnatal depression with behavioural and emotional problems in children at 4 years of age (O'Connor, Heron, Glover, & The ALSPAC Study Team., 2002). This information should be used to inform Lead Maternity Carers, childbirth educators and other health professionals about the need to be aware of low help seeking behaviour in perinatal women.

Objective 2

The second objective of the current study was to report the prevalence, in this convenience sample of women, of perinatal distress (including stressful life events, worry, anxiety and postnatal depression) in the third trimester of pregnancy, in the first eight weeks postpartum and at three months postpartum.

The prevalence of symptoms of perinatal distress was generally consistent with previous research (Gavin et al., 2005). Levels of depression, anxiety and worry were higher in the third trimester than at 3 months postpartum. At 3 months postpartum, Māori women reported that they experienced significantly more stressful life events in the previous twelve months than non-Māori women. The prevalence of depression was also higher among Māori women, but there was no difference by ethnicity in the prevalence of anxiety.

Prenatal depression

The EPDS was used to screen for symptoms of minor and major postpartum depression using previously established cutoffs of greater than 9 (symptoms of minor depression) and greater than 12 (symptoms of major depression) respectively. Depression was most prevalent in the prenatal period when 36% of women met the criteria for minor depression and 17% met the criteria for major depression. This is consistent with an Australian study that reported the prevalence of moderate to severe depression in the third trimester to be 16.9% (Leigh & Milgrom, 2008). In a meta-analysis of perinatal depression studies, Gavin et al. (2005) reported that as many as 18.4% of women experience depression during pregnancy and that for 12.7% of women this will be a major depressive episode. Gavin et al. excluded from their meta-analysis all studies based solely on self-report measures of depression and this could explain, at least in part, the lower rate reported by them.

Although one third of women in the E Moe, Māmā, Hauora Hinengaro study reported a history of mood disturbance prior to the current pregnancy, it was not ascertained if women were experiencing depression when they became pregnant.

The blues

Experiencing the postpartum or baby blues is widely reported across cultures and this study was no exception. In total 63.9% of women reported having had the blues with non-Māori more likely than Māori women to report this experience. For 26.6% of women the blues were prolonged, lasting more than a week and mean EPDS scores were significantly higher when this was the case. Women should be informed of this

relationship during the antenatal period and made aware that prolonged baby blues may be the prodromal stage of a postpartum depressive episode. In light of the finding regarding help seeking, women should also be encouraged to seek early assessment to allow monitoring and treatment as appropriate.

Postnatal depression

By three months postpartum the rates of women meeting the criteria for minor depression (16.3%) and major depression (7.8%) were less than half that reported in pregnancy. In a survey of postpartum New Zealand European and Māori women, using the EPDS with the cutoffs of 9 and 12 respectively for minor and major depressive symptoms, Webster et al. (1994) reported prevalence of 13.6% for minor depressive symptoms and a further 7.8% for major symptoms. Thio et al. (2006) excluded non-European women from their analyses of 225 postpartum women surveyed in New Zealand. Using the same thresholds they reported prevalence of minor depressive symptoms to be 13.8%, with a further 16% meeting the criteria for major depression. Finally, Abbott and Williams (2006) assessed the prevalence of postpartum depression using only the upper EPDS cutoff of greater than 12 with mothers of Pacific island ethnicities. They found that rates diverged widely from 7.6% for Samoan mothers to 30.9% for Tongan mothers. Overall, they reported the prevalence of depression to be 16.4%. All three of these New Zealand studies were confined to the Auckland region.

Internationally, Leigh et al. (2008) reported prevalence of 11.2% for moderate to severe depression at 10–12 weeks postpartum and Gavin et al. (2005) reported in their meta-analysis that as many as 19.2% of new mothers experience major or minor depression in the first three months postpartum and for 7.1% of women this will be a major depressive episode.

The prevalence of postpartum depression reported in the present study is consistent with that seen in prior studies, but may also have been influenced by the protocol followed when women reported high levels of depressive symptoms on the EPDS in late pregnancy. Any woman who scored above 12 on the EPDS was contacted and advised of this result. If the woman chose, her nominated health professional was also advised and women were encouraged to seek appropriate assessment and treatment. This intervention meant that a number of women who screened positively for depressive symptoms in the third trimester or first two months postpartum would have been receiving treatment in the third postpartum month. The number of women reporting postpartum depressive symptoms may therefore have been influenced (reduced) by this process. Further investigation of this type of relatively simple and cost effective

intervention is warranted to establish if early identification is one way of preventing or reducing the onset of postpartum depression.

Māori women were more likely than non-Māori women to report symptoms of both minor and major depression during pregnancy but this association disappeared in the postpartum period, especially for major depression. Depression and anxiety are more prevalent in Māori in the general population and it is unclear why this relationship was not seen in postpartum women in the E Moe, Māmā: Hauora Hinengaro study. One possibility is that at this time all women in the study reported the availability of high levels of emotional support, guidance and advice and perhaps this level of support is particularly germane for Māori women during the perinatal period. New parents often experience an influx of support from friends and family in the early postpartum. Both Māori and non-Māori women reported similar, very high levels of emotional support and advice at three months postpartum, especially from friends and family outside of the home. Future research following women through and beyond the postpartum year could ascertain what aspects of social support are protective against postnatal depression and when the differences in mood symptomology reappear between Māori and non-Māori women.

Another explanation relates to help seeking. As previously noted, Māori have identified barriers to getting assistance for breastfeeding. Similar barriers could be expected to exist when it comes to help seeking for mood disturbance. Several factors in the current study may have positively influenced the pathway of depression from pregnancy to the postpartum period. First, a number of women reported anecdotally that they found participation in the study helpful. It encouraged them to think more about their sleep and mood and stimulated discussion with family members and in some cases with a health professional. In this way women may have elicited more help and social support than might otherwise have been the case. Second, the protocol when women scored highly on the EPDS, may have acted as an intervention in itself. Although not all women reacted favourably to the follow up phones calls, many reported that even just talking with the research team about their score and their current mood was helpful. They appreciated the calls and felt supported. The calls and referrals to health professionals then set in place further assessment, monitoring and treatment.

A third factor may have been the influence of the kaupapa of this study. Unlike previous research on depression in New Zealand women, the needs of Māori women were prioritised according to the principles of Kaupapa Māori methodologies which included Māori participation and control in all aspects of the research. While difficult to quantify, being able to speak to a member of the research team who was Māori, and application of the tikanga of whānaungatanga (kinship, relationship), manaakitanga (hospitality) and

kaitiakitanga (guardianship) may have had a positive influence on Māori participants. Investigators are encouraged to explore more fully the potential benefits for participants of research conducted in this way.

Of the 74 women in the study who met the criteria for major depression at three months postpartum, half (49%) met the same criteria (EPDS>12) in the third trimester of pregnancy, and half (51%) also met the same criteria, using the EPDS-3A, in the first two months postpartum. Twenty-seven percent of women reported persistent symptoms of depression, meeting the criteria for probable major depression at all three time-points measured. There was also a group of women (18%) who met these criteria in the third trimester of pregnancy, and again at three months postpartum, but who reported non-clinical levels of depressive symptoms in the first two months postpartum. Women are screened for depression during the immediate postnatal period (up to 6 weeks postpartum) while they are still under the care of their Lead Maternity Carer. This finding suggests that approximately one in five women have persistent depression or a relapse of depression which is not detected by using a brief measure in the first two months postpartum.

It is possible that the brief measure was not sensitive to depression, but the high rates of women scoring above the cutoff of 12 at this time indicate that the measure may be over-sensitive rather than under-sensitive. Another explanation for this finding reflects the factor structure of the EPDS. Although the EPDS-3A has been validated as a brief screen for depression (Kabir et al., 2008), the items included have been identified as reflecting the anxiety dimension of postnatal depression. Either way, this highlights the complexity of measuring perinatal distress, including the relationship between anxiety and depression which are commonly, but not necessarily, comorbid (Matthey et al., 2001).

One further explanation is that during the initial weeks, social support may be high as partners take leave to be with their newborn; family and friends are actively involved in supporting the new family; and the woman's Lead Maternity Carer, who is usually a midwife, is making regular visits and is readily contactable. By 3 months postpartum sleep deprivation is chronic for many women and social support within the home is likely to be dramatically reduced as partners return to usual work hours and the Lead Maternity Carer relationship ends. This observation warrants further investigation to determine the temporal relationship between screening for postnatal depression and actual cases of depression.

Anxiety

Anxiety was investigated using the EPDS-3A and the BMWS (which measures worry as the cognitive aspect of anxiety) in the postal surveys competed in the third trimester and at 11–13 weeks postpartum. As previously discussed, women also completed the EPDS-3A during a telephone survey between 3 to 8 weeks postpartum. Rates of perinatal anxiety have not previously been reported for New Zealand women.

There were no significant differences in anxiety between Māori and non-Māori women, as measured by the EPDS-3A or the BMWS. As with depressive symptoms, anxiety and worry were highest in late pregnancy. At that time, mean anxiety scores were just above 12 (inflated mean 12.2, *SD* = 7.12). Comparing this to the mean for the full EPDS score in pregnancy (7.98) could indicate that women in this sample were more likely to feel anxious than depressed. Sixty-nine percent of women scored above 9 and 53% of women scored above 12 on the EPDS-3A. These rates are considerably higher than those reported by Leigh et al. (2008). Using the Beck Anxiety Inventory at 26 to 32 weeks antenatal they reported that 28.8% of women reported symptoms of mild anxiety and 27.7% reported symptoms of moderate to severe anxiety. This suggests that women in the E Moe, Māmā: Hauora Hinengaro study were much more anxious than women in other antenatal groups of women or that the EPDS-3A is a particularly sensitive measure. It also highlights the need to develop validated measures of anxiety specifically for perinatal women (Matthey, Barnett, Howie, & Kavanagh, 2003).

At 11–13 weeks postpartum almost half of all women scored above 9 on the EPDS-3A (46.7%), with 28.5% scoring over 12. There were no differences at any time between the proportions of Māori and non-Māori experiencing anxiety. Although not diagnostic, these high levels of anxiety symptoms indicate large numbers of women are affected by this aspect of perinatal distress. Anxiety is not as widely reported as depression in the perinatal literature and this may be due in part to its high co-morbidity with depression, as well as because of the range of anxiety disorders (e.g. generalised anxiety, panic disorder and social anxiety) which may be prevalent during this period (O'Hara & Wisner, in press). Further research is required with a focus on the consequences of anxiety for perinatal health, well-being and outcomes.

A cutoff of 12 is used on the BMWS to identify women who are high in worry. During pregnancy, 12% of women in the current study met this criteria and this reduced to 7% at 3 months postpartum. While following the same pattern of being high in the third trimester and lower in the postpartum period, these proportions of women reporting symptoms of anxiety/worry are considerably lower than those captured by the EPDS-3A. Further investigation of the dimensions of anxiety experienced by perinatal women is

warranted so as to allow interventions to target the underlying mechanisms of anxiety. For instance, one item in the EPDS-3A asks about feeling scared or panicky, which relates to fear and another asks about blame which relates to guilt. A number of items in the BMWS ask about the *consequences* of worry, such as the interference of worry in getting work done or making decisions. All of these items may be relevant to perinatal women and this suggests that multi-method evaluation of perinatal distress is important.

Objective 3

The third objective of this study was to investigate the relationship of perinatal sleep with depressive symptoms at 3 months postpartum.

Five hypotheses relating to Objective 3 were tested using a series of hierarchical linear regression analyses. Three groups of factors were investigated in relation to levels of depression at 3 months postpartum. These were: demographic items (ethnicity, age and socio-economic position); previously recognised risk factors for postnatal depression (antenatal depression, social support measured as happiness in partner relationships, and the number of stressful life events experienced in the previous year); and seven groups of sleep related factors, including: sleep quantity and change in sleep quantity; sleep quality and change in sleep quality; snoring and restless legs syndrome.

No association was found between levels of depression at 3 months postpartum and ethnicity, maternal age or small area index of socio-economic deprivation. Together these demographic factors explained only 1% of the variance in postpartum depression levels. Although Māori were more likely than non-Māori women to report symptoms of depression in pregnancy, as previously discussed, this relationship was not seen in the relation to the outcome of interest, which was postnatal depression at 3 months postpartum. The role of socio-economic deprivation in these relationships has already been discussed and this finding reiterates the need for future studies to include multiple measures of socio-economic position.

With regards to age, previously reported rates of anxiety and depression are highest in the general population and among Māori between the ages 16-44 years, compared to any other life stage (Ministry of Health, 2006). This mirrors the age range of women who participated in the current study. Previous studies have also found no age-related differences in the prevalence of depression measured using the EPDS in perinatal women (e.g. Josefsson, Berg, Nordin, & Sydsjö, 2001).

Consistent with past studies (Milgrom et al., 2008; Robertson et al., 2004), the previously recognised risk factors for postnatal depression investigated in this study were

all found to exert an independent significant effect on postnatal depression. Together these factors explained 25% of the variance in levels of postnatal depression.

Large effect sizes for depression in the third trimester of pregnancy were estimated in all but one of the regression models used to investigate these relationships. Given that sleep duration, sleep quality and depression levels were all at their poorest in the third trimester, this appears to be a time when women are most vulnerable. Despite this, neither sleep health nor depression are routinely screened for at this time. Bei et al. (2010) used the term "harshest mixture" to describe postpartum sleep disruption. This descriptor holds true in the present study and is even more relevant to the period of late pregnancy.

Social support from a partner was also significantly related to postpartum depression. Compared to women who felt happy, women who were ambivalent about, or unhappy in their partner relationships reported higher levels of postnatal depression. While significant, the effect sizes for happiness in partner relationship and number of stressful life events experience were small. Nonetheless, relationship ambivalence and unhappiness appear to be extra stressors for women in the postpartum period.

The independent contribution of sleep quality to postpartum depression was first tested in a general sleep model, which also included sleep duration at 3 months postpartum. Sleep quality was investigated using two subscales from the GSDS (sleep onset latency and effect of sleepiness on daytime function) as well as a measure of the number of good night's sleep obtained per week. In this initial model the GSDS sleep quality variable, but not good night's sleep or sleep duration, were significantly related to postpartum depression. Together, demographic factors, recognised risk factors for postpartum depression, sleep duration, difficulty falling asleep and the effect of sleepiness on daytime function explained 39% of the variance in levels of postpartum depression.

Difficulty falling asleep and negative effects of sleepiness on daytime functioning were both independently associated with higher levels of depression at 3 months postpartum. Given the chronic reductions in sleep duration, and the fragmentation of sleep from infant feeding, care and other disturbances, the two process model of sleep would suggest that homeostatic pressure for sleep would be high in postpartum mothers. This could be expected to be associated with short sleep onset latencies—in other words, *falling asleep* should not be a problem for mothers of young infants. In fact, during the telephone survey calls, many women reported that falling asleep was not a problem at all reporting comments like "I'm sure I'm asleep before my head actually hits the pillow." Therefore, having difficulty falling asleep may to be a key indicator of negative affect in the postpartum population. These results reinforce the findings from a growing number of

studies in this area (Dorheim et al., 2009a; Goyal et al., 2007; Posmontier, 2008). For instance, Goyal et al. (2007) reported that sleep disturbance was associated with depressive symptoms in the third trimester of pregnancy and the third month postpartum and in particular, difficulty falling asleep (delayed sleep onset) was most associated with the highest levels of depressive symptoms. Asking women about their ability to fall asleep easily may be a simple yet significant measure to include in perinatal health assessments.

Sleep duration and postpartum depression

In the current study, hypothesis 1 was that women who reported obtaining less perinatal sleep would report higher levels of depression at 3 months postpartum compared to women who obtained more sleep. Postpartum (but not prenatal) sleep duration was found to be independently associated with higher levels of depression at 3 months postpartum.

Although sleep duration was at its lowest in late pregnancy, this was not associated with postpartum depression. After controlling for the groups of demographic items and previously identified risk factors for postpartum depression, sleep duration in the second month postpartum (T3) and at three months postpartum (T4) were found to be significantly associated with postpartum depression. Less sleep at these times was associated with higher levels of depression. Causality cannot be inferred from these findings and the relationship between sleep and depression is currently understood to be bi-directional in nature. However, it does appear that women who either continued to experience reduced sleep compared to pre-pregnancy levels, or experienced a reduction in sleep for the first time in the perinatal year *after* they had given birth, were more likely to have symptoms of postpartum depression. Monitoring sleep duration across the perinatal year, and paying particular attention to women whose sleep duration declines from the prenatal to the postnatal period should therefore be recommended as part of routine perinatal health care. Future research should investigate the trajectory of changes in sleep duration across the perinatal year, in depressed and non-depressed women, to further elucidate the possible pathway and effects of changes such as those seen in the present study.

Sleep quality and postpartum mood

Hypothesis 2 in the current study was that women who reported poor perinatal sleep quality would report higher levels of depression at 3 months postpartum compared to women who reported less disturbed sleep.

Good night's sleep followed the same pattern as sleep duration so that the number of good night's sleep was highest before pregnancy, lowest in late pregnancy and although improved by 3 months postpartum, this dimension of sleep quality had not returned to pre-pregnant baseline levels.

When considering the relationship between sleep quality and depression at three months postpartum, reporting fewer good night's sleep per week before pregnancy and, most significantly, at 3 months postpartum was associated with postpartum depression. Usual pre-pregnant sleep quality, but not usual sleep quantity, was associated with postpartum mood. One possible explanation for this finding is that women with poor sleep quality prior to becoming pregnant may be more vulnerable to depression in the postpartum period. Alternately, women who were already depressed when they became pregnant were likely to also have poor sleep quality. However, this explanation, which assumes pre-existing and chronic depression, is not supported by the lack of association between poor sleep quality in late pregnancy (when women obtained the fewest good night's sleep) and postpartum depression.

Change in sleep duration and postpartum depression

The third hypothesis in this study was that women who reported greater change in perinatal sleep duration would report higher levels of depression at 3 months postpartum compared to women who reported less change in sleep duration. Previous postpartum depression research has not reported on the relationship between mood and the *magnitude* of change in sleep durations across the perinatal year.

Once again, although sleep duration was at its lowest and depression levels were at their highest in late pregnancy, the magnitude of change in sleep in the prenatal period was not associated with postpartum depression. In contrast, the magnitude of change in sleep durations from all time points to any postpartum time point were all significantly associated with postpartum depression. Greater reductions in postpartum sleep were related to higher levels of postpartum depression. The change from sleep in the third trimester of pregnancy to three months postpartum had the largest effect size, although it is still considered small according to Cohen's guidelines for interpreting partial eta squared (Cohen, 1988; Pallant, 2007). This suggests that women whose sleep duration continues to deteriorate across the perinatal year, into the postpartum period, are more vulnerable to postpartum depression. As yet unidentified mechanisms may be affecting sleep in these women, or the reciprocal relationship could be true so that when women have persistent depression this mood disturbance negatively impacts their sleep. This relationship could also be bi-directional, acting as a vicious cycle between poor mood and

poor sleep in the most affected women (Abad & Guilleminault, 2005). Poor sleep may both predispose women to poor mood and perpetuate depressive symptoms.

Individual variability in habitual sleep duration is increasingly being recognised in sleep literature, although the functional significance of such differences is still to be determined (Tucker et al., 2007). It is possible that the consequences for the women who experienced a larger change in TST from their usual pre-pregnant baseline may be more profound than for those whose TST varied to a lesser degree across the peripartum. There is also growing evidence that individual trait-like vulnerabilities to sleep loss exist so that some women will be more adversely affected by even small changes in sleep quantity or quality, while others are able to tolerate bigger changes (Van Dongen et al., 2004). In either case it may be beneficial for women to compare the amount of sleep they needed in order to function well prior to pregnancy with their current usual sleep duration. This would enable them to consider the type and level of sleep-related risks they might be exposed to, and make adjustments such as finding ways to increase or recover sleep, as well as avoiding risk-related activities such as drowsy driving.

Change in sleep quality and postnatal mood

Hypothesis 4 was that women who reported greater change in perinatal sleep quality would report higher levels of depression at 3 months postpartum compared to women who reported less change in sleep quality.

The magnitude of change in sleep quality, as measured by the number of good night's sleep obtained per week, was also significantly related to levels of postpartum depression. As was the case with the percentage change in sleep duration, there was no association between the magnitude of change in usual sleep quality from prior to pregnancy to late pregnancy. The magnitude of change in sleep quality from prior to pregnancy to 3 months postpartum was significantly associated with postpartum depression levels as was the magnitude of change from late pregnancy to 3 months postpartum. Women who experienced a greater percentage decrease in the number of good night's sleep obtained also reported higher levels of depressive symptoms at 3 months postpartum.

In the current study, both the magnitude of decline and a perception of continued decline in sleep quality were related to postpartum depression. Previously, Bei et al. (2010) used both objective and subjective measures to investigate relationships between sleep and postpartum mood and reported that only subjectively reported sleep-related daytime dysfunction and perception of sleep were significantly predictive of postpartum mood at one-week postpartum. This distinction is important because it informs the type of

assessment and interventions that may be required to assist women. Women should be assessed not just for postpartum depression but also for changes in the quantity and quality of their sleep. Multi-method assessments will help give a more precise formulation of which aspects of sleep are most affected as well as the chronicity and magnitude of sleep and mood disturbance.

Depressed women or women who have experienced significant changes in sleep quantity or quality (or both) may benefit from interventions which take a biopsychosocial approach. Behavioural and environmental improvements may be achieved by addressing sleep hygiene practices. Physical approaches should address the treatment and management of pathological symptoms such as pain or incontinence which may be affecting sleep. These measures have the potential to improve sleep quality by minimising unnecessary disruptions to sleep at this time. Cognitive and emotional approaches could be targeted towards creating realistic expectations about postpartum sleep, addressing worry and cognitive hyperarousal and introducing women to mindfulness strategies of acceptance and non-judgment. These measures have the potential to improve sleep quality by changing women's perceptions so that postnatal sleep disruption is viewed with minimal negative attribution.

In the analyses completed for this study, antenatal depression exerted the greatest effect on postnatal depression of any factor investigated. The effect of antenatal depression on postnatal depression was large in all but one of the hierarchical regression models calculated in this study, and in that case the effect size was at the upper end of the medium range. This is consistent with a growing number of studies that have recognised the effect of depression in pregnancy on postpartum mood (Beck, 2002; O'Hara & Swain, 1996; Robertson et al., 2004). The relationship between poor sleep and poor mood in the general population is well established. Sleep duration and sleep quality were at their poorest during the antenatal period for women in the current study, at the same time that symptoms of depression and anxiety were also at their highest.

If sleep is considered to be a transdiagnostic factor, and therefore a common mechanism associated with a multitude of disorders including depression and anxiety, then the current findings provide compelling evidence for the need to assess both mood and sleep during pregnancy. Although prenatal sleep is impacted by a range of physiologic changes associated with pregnancy, such as urinary frequency, which may not be easily modifiable, women in this study also identified a number of environmental and psychological factors disturbing their sleep and these may respond to intervention. For instance, factors in the bedroom environment identified by women in this study as disturbing sleep, such as temperature, comfort and the presence of pets, all have the

potential to be modified. Education about sleep hygiene has been used as an effective intervention in non-pregnant populations with insomnia (Stepanksi & Wyatt, 2003) as well as with new mothers (Lee & Gay, 2011).

Almost half of all women in the study reported being disturbed in pregnancy, on three or more nights per week, by thinking, worrying or just not being able to sleep. Worrying and repetitive thinking represent the cognitive dimensions of anxiety (Austin et al., 2007; Carney et al., 2010). During pregnancy 11% of Māori and 12.8% of non-Māori women reported high level anxiety using the BMWS. In a study of 748 women Austin et al. (2007) found that women who reported this level of antenatal worry were 2.6 times more likely to have postpartum depression. Cognitive behavioural therapy for insomnia (CBT-I) has been found to be effective in treating individuals with primary insomnia as well as others who have insomnia secondary to another medical or psychiatric condition (Carney et al., 2010; Smith & Perlis, 2006). Swanson et al. (2012) are the first to successfully trial CBT-I using a form modified for postpartum women. Given the findings in the E Moe, Māmā: Hauora Hinengaro study, this intervention urgently needs replication and to be adapted for use with women across the perinatal period.

Study limitations

The major limitation of this study is that findings drawn from this convenience sample of pregnant and postpartum women may not generalise to the wider perinatal population. However, the data and findings in the current study are largely consistent with previous reports across a number key factors including the temporal patterns of change in sleep duration and quality and the prevalence of symptoms of postnatal depression. It is acknowledged that causality cannot be inferred from any of the findings.

Few studies have measured sleep duration across the perinatal year and this is probably due in part to the challenge of engaging women in research who *might* become pregnant. In the present study less than half of Māori women reported that they were trying to become pregnant. Questions relating to the women's non-pregnant sleep duration, sleep quality and symptoms of sleep disorders were therefore asked retrospectively and may have been subject to recall bias.

The distribution of sleep duration was wide, with small numbers of women reporting total sleep durations as short as 2 hours and as long as 17 hours. There are no guidelines for defining a plausible range of sleep durations in research. In their study of over one million adults, Kripke at al. (2002) considered a response of less than two hours or greater than sixteen to be invalid, however, no rationale was given for this range. In the

present study all sleep values from two to seventeen hours were retained for analyses as there was no theoretical basis for applying Kripke's rule. This reiterates the challenges associated with using subjective data.

An important aspect of the kaupapa of this study was the aim to recruit equal numbers of Māori and non-Māori women. Although this goal was not met, and the ratio was 1:2 Māori to non-Māori, the sample represents the largest number of Māori and non-Māori New Zealand women to be investigated in relation to sleep, mood and the perinatal period. Further, the recruitment methods developed in this study focused on the needs of both Māori and non-Māori women, and have added to the literature on engaging indigenous women in longitudinal research (Pilcher & Huffcutt, 1996). Differences between groups were still able to be detected and have been reported accordingly.

The EPDS was used to assess symptoms of depression in this perinatal population and although this measure has been validated with Samoan and Tongan women in New Zealand, it has not yet been validated for use with Māori. Given the widespread use of the EPDS in assessing perinatal mental health, that Māori are the indigenous people of New Zealand, and that this is a growing population, validation of this measure with Māori is urgently required.

Study strengths

The large sample size in this study is strength of this study, as is its longitudinal design which allowed the investigation of some aspects of the temporal relationship of sleep and mood in the perinatal year.

A third strength is that this study took into account a range of the wider determinants and known risk factors of mental health, including age, ethnicity, socio-economic position, social support, stress and depression in pregnancy.

Although self-report measures have limitations, it is also possible that questionnaires and processes like those used in the E Moe, Māmā: Hauora Hinengaro added strength to the research. Women in this study were able to complete questionnaires in their own time, in their own place and at their own pace. This interpersonal distance may create space, and allow women to express themselves more freely (Barber, 2009).

It also appears that women's subjective perceptions of their sleep, such as the number of good night's sleep they have and the ease or difficulties they have in falling asleep and staying asleep, may be a key part of the relationship of sleep to postnatal depression.

Chapter Five

Study Two—The PIPIS Study

Method

Summary

The PIPIS study was a small scale trial of a behavioural-educational sleep intervention for first-time mothers. Participants completed the same written questionnaires as women in Study One. In addition, participants attended a prenatal information only session (control group) or sleep education session (intervention group) at the Sleep/Wake Research Centre (Massey University, Wellington). Women in this study were recruited separately to participants in the main study and completed extra questionnaires, maternal and infant sleep diaries and all mother-infant pairs undertook actigraphic sleep/wake monitoring in their own homes on two occasions.

Participants

Recruitment

This study was introduced by the researcher to women in the last trimester of pregnancy at a community childbirth education class. Women were recruited through the childbirth education classes of a single provider organisation (Parents Centres New Zealand) offering classes in two demographically similar, but geographically distinct, areas. Recruitment took place over a period of seven months from August 2010 to February 2011. Those who expressed any interest in the research were given a study information pack to take away and consider in their own time. The pack contained an introductory cover letter, an information sheet, a consent form and the first questionnaires (Appendix 8). Signed consent forms were posted to the research team in a pre-addressed, reply-paid envelope. Recruitment occurred in several rounds in line with scheduled 7-week childbirth education classes.

Each site was designated as either an intervention site or a control site and this assignment alternated for each round of recruitment. In total, four rounds of recruitment

were necessary to obtain the required sample size. Every effort was made to conceal group assignment; full 'blinding' to study condition was not possible as a requirement by the guiding ethics agency was to specify the possibility of assignment to one of two groups, each receiving different levels of sleep information, different amounts of contact and different durations of sleep 'information' session.

Participants received a $50 koha after attending the prenatal education or information session, and a $20 koha after completion of each of the three measurement phases of the study at 35-37 weeks gestation, 6-weeks and 12-weeks postpartum, making a total koha of $110.

Sample size

Although the PIPIs study was run as a pilot study, power analyses were conducted to determine sample size. A previously published pilot study, similar in design to the PIPIS study, was successfully completed with a total sample size of 30 postnatal women (Stremler et al., 2006). In that study nocturnal TST for the control group was 376 minutes (*SD* = 22) and for the intervention group nocturnal TST was 433 minutes (*SD* = 15.8). There were 15 participants in each group and the 57 minute between group difference in nocturnal TST represented an effect size of $d = 2.94$ at $\alpha = .05$ which is considered a large effect size according to Cohen's effect size conventions (Cohen, 1988). A more conservative difference in nocturnal TST of 30 minutes was also tested, using the same sample size and a large effect size remained ($d = 1.55$ at $\alpha = .05$). Two online calculation programs were used to complete these tests: http://www.uccs.edu/~lbecker and www.dssresearch.com/KnowledgeCenter/toolkitcalculators/statisticalpowercalculators.aspx. A target sample of 20 participants per group was therefore chosen to allow for potential dropout. Introduction of the project at childbirth education classes proved to be popular and enrolments exceeded 40 participants in total.

Selection criteria

Women were included in the study if they were 1) over 16 years of age, 2) having their first baby, which was a single foetus (not twins or multiples), 3) able to complete the study questionnaires in English, 4) had a telephone, and 5) planned to provide full-time care to their baby for at least the first 12 weeks after birth. This final point was considered important so as to allow for a consistent approach to childcare, especially in relation to infant sleep, and to ensure the mother would be able to complete actigraphy and 48-hour sleep diaries for herself and her infant, as required, on two occasions. In order to limit participation to novice parents, with no prior experience of childbirth, parenting or strategies for managing

perinatal sleep, exclusion criteria were 1) women or women with partners who had experienced a stillbirth or perinatal death at greater than or equal to 20 weeks gestational age (women with previous miscarriages at less than 20 weeks gestation were eligible); and 2) women whose partner had children from another relationship. Additional exclusion criteria addressed factors which could impact sleep directly, but which were not the focus of this research. These were: 3) women with current uncontrolled chronic illness; 4) use of prescription medications that affect sleep (for example, benzodiazepines); and 5) women, or women with partners, with a diagnosed sleep disorder. Inclusion/exclusion criteria were outlined at the initial recruitment visit, in the study information sheet and were reiterated at the information session that all participants attended after consenting to participate.

In total, 40 women completed all stages of the PIPIS study. All women reported that they were living together with a partner or husband and having their first baby. Detailed characteristics of the study's participants are described in this section.

Figure *13* illustrates the flow of participants through each stage of the study.

Originally 43 women enrolled in the study, n = 20 intervention group and n = 23 control group. One woman attended the information session but then withdrew from the study after the birth of her infant as she felt study completion would be too demanding for her at that time. One woman attended the information session and was highly motivated to remain in the study, but further data collection was compromised by multiple hospital admissions for breastfeeding problems. A third participant was also highly motivated to participate in all stages of the study, despite discovering just prior to birth that her infant had Trisomy 21 (Down Syndrome). Trisomy 21 is often characterised by, among other things, glossoptosis (large, posteriorly placed tongue) and adenotonsillar hypertrophy, and can be associated with congenital heart abnormalities. Because these features can all impact sleep development (Mindell & Owens, 2010) the data of this mother–infant pair were not included for analyses.

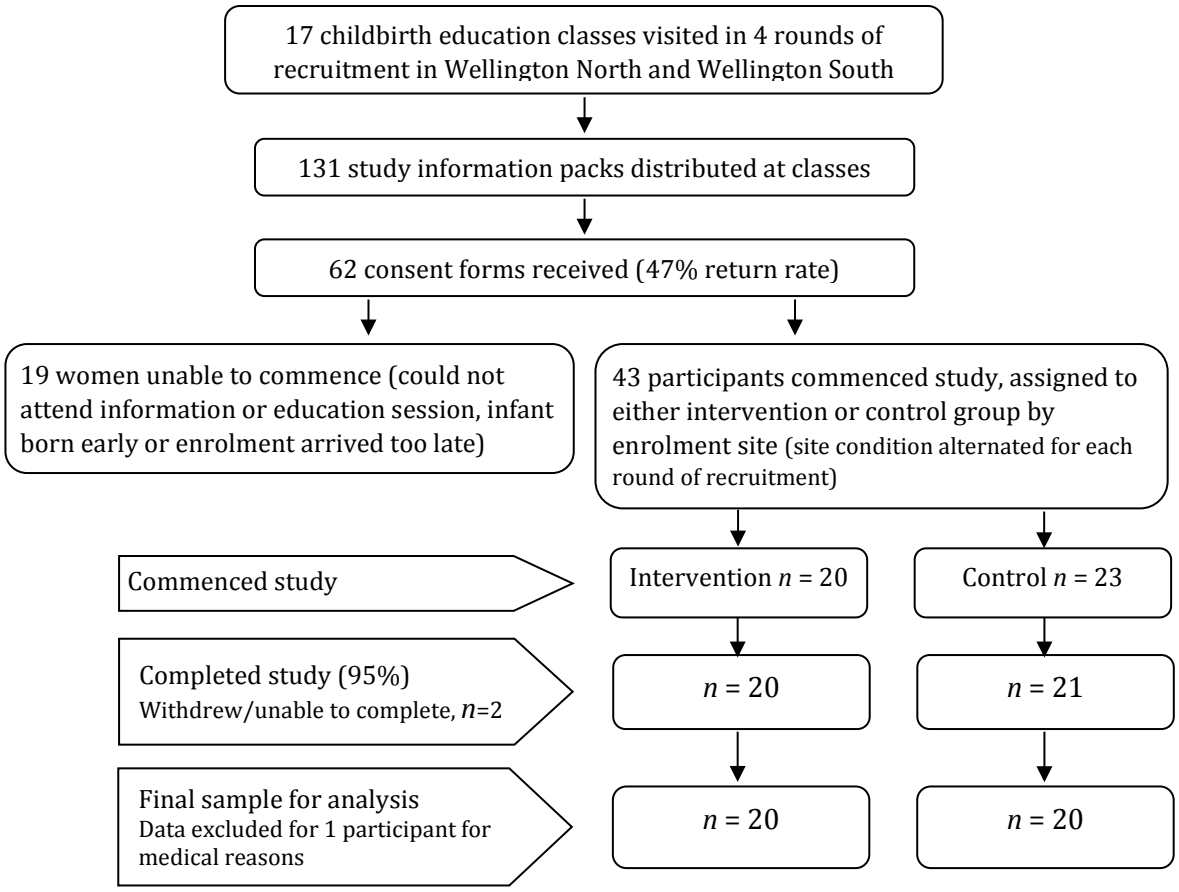

Figure 13. Flow of participants through the PIPIS Study.

Ethics

Ethical approval was given by the New Zealand Health and Disability Ethics Committee, approval number CEN 09/09/070 (Appendix 3). Women participating in the PIPIS study gave written consent for their own and their infant's participation. The same process described on page 70 (Study One–Methods) was used to deal with elevated scores on the EPDS.

Behavioural-educational sleep intervention procedure

Intervention group

The sleep education intervention comprised a 2¼ hour, small-group, prenatal education session. Participants had either completed, or were still attending, a childbirth education class in the same geographic area. The education session took place in the evening and used a similar format to a regular childbirth education class. Partners were

encouraged, but not required, to attend this session. Questions about any aspect of sleep or the study were encouraged. The last 10 minutes of the session were dedicated to explaining how actigraphic monitoring would be conducted.

Women received a *PIPIS Pack* containing a PIPIS booklet, a relaxation audio recording, and public health fact sheets on safe sleeping for infants (*Safe Sleep Essentials* produced by Change for our Children, Appendix 9) and recognising signs of infant illness (*Child Sickness, Danger Signals*, produced by the Ministry of Health, Appendix 10). The relaxation audio recording called "Relax for Health" was supplied to participants on a compact disc. The recording was produced by the Mental Health Foundation of New Zealand and contains a number of guided relaxation sessions, which participants were encouraged (but not required) to use both before and after the birth of their baby. Women were referred back to these resources during weekly follow-up calls whenever opportune.

Women (or partners) were instructed to advise the birth of their infant (including actual date of birth), by email, telephone or text message. If birth had not been advised by one week post the estimated due date, an email message was sent noting that birth would not be far away now and, if the baby had arrived in the meantime, an update of details would be welcome. This process was followed for both the intervention and control groups.

Weekly support calls were initiated over five weeks commencing after the seventh postnatal day. It was not possible to contact every woman for every call, as women were often napping, out, or busy with baby care, and could not always be reached (all women took part in at least two calls and 75% of women took part in four or more of the weekly calls). The researcher enquired about life in general with a new baby, feeding and sleeping. Participants were encouraged to share any questions or concerns they had about their sleep or their baby's sleep. The researcher also reminded women about specific strategies, such as putting the baby to bed awake but ready for sleep, relaxation, and tips, ideas and information in the education book. Calls were initiated between 10 a.m. and midday so as not to disturb the new mothers too early in their day, whilst obtaining a measure of sleep within a consistent time of day. This was not always possible as any requests by mothers to call at a different time were respected and adhered to. A copy of the intervention group telephone call schedule can be found in Appendix 11.

Control group

Participants attended a 45 to 60 minute, small group information session. All women had either completed, or were still attending, a childbirth education class in the same geographic area. This session was also modelled on a regular childbirth education

class, (albeit shorter in duration) and took place in the evening. Partners were encouraged, but not required, to attend this session. Women received a one-page information hand-out with general sleep hygiene tips (Appendix 12) and these were outlined by the presenter. The rest of the time was dedicated to explaining how actigraphic monitoring would be conducted and completing administrative tasks, such as checking contact details. Questions about the study process only were encouraged. Content of the hand-out was based on basic sleep hygiene information at a level readily accessed on the internet (for an example see *The Basics of Good Sleep* at www.babycenter.com.au) or in pregnancy related or general women's magazines. Control group women also received the *Safe Sleep Essentials* and *Child Sickness, Danger Signals* fact sheets.

No on-going telephone support was offered to the control group. Maintenance-only telephone calls were made when the infants were 2 weeks and 4 weeks old, with the intention of staying in contact with women and increasing compliance to complete all aspects of the study. Participants were asked about their own sleep duration in the previous 24 hours, number of sleep episodes and the quality of their sleep. No opportunity was created for sleep or infant related questions. In order to control for this possibility, these calls were made by a researcher who was not otherwise involved in the project, and who was instructed to respond that she was unable to offer information or assistance of this kind. A copy of the control group telephone call schedules can be found in Appendix 13.

Measures

Late pregnancy

All women in the PIPIS study completed the Sleep and Health during Pregnancy Questionnaire between 35–37 weeks gestation. At the same time, all women completed the PIPIS Pregnancy Questionnaire (Appendix 14). This questionnaire asked about the woman's plans for feeding her infant, plans for where her infant would sleep, partner agreement on both these plans, and whether or not anyone living in her home participated in work at night, as this could impact the sleep she might otherwise obtain during actigraphy monitoring.

6-weeks postpartum

All women received a PIPIS Project 6-week Questionnaire (Appendix 15) during a home visit to set up the actigraphy study. The questionnaire includes items relating to infant feeding, partner support for infant feeding practices, infant sleep location, partner

agreement over infant sleep management, sleep disturbance (GSDS), mood (EPDS and BMWS), infant health, strategies and sources of information used with regard to infant and maternal sleep and whether or not participants described their own sleep and their infant's sleep to be a problem. Participants were asked to place a tick mark (✓) next to any strategies or sources of information they found helpful and a cross (×) next to any strategies or sources of information that were unhelpful. Two versions of the questionnaires were used – one for control group participants and one for intervention group participants with the only difference being that intervention group mothers were asked specifically about strategies suggested in the education session and PIPIS booklet. The questionnaire was collected by the researcher at the end of the actigraphy study (usually three days later).

12-weeks postpartum

At 12-weeks postpartum all women completed the Postnatal Sleep and Health Questionnaire and the PIPIS Project 12-weeks Questionnaire (see Appendix 16). This PIPIS Project 12-weeks Questionnaire is a repeat of the PIPIS Project 6-weeks Questionnaire minus the GSDS, EPDS and BMWS, which were already contained in the Postnatal Sleep and Health Questionnaire.

Postpartum actigraphy

In order to objectively measure the sleep of mothers and infants participating in the PIPIS study, all mother-infant pairs completed 48 hours of continuous actigraphic monitoring at 6-weeks and 12-weeks postpartum, in their own homes. Wherever possible, the monitoring days were scheduled to avoid weekends, when sleep patterns may differ from weekdays due to reduced work commitments for partners. During a telephone call to schedule an actigraphy setup home visit, mothers were asked not to schedule immunisations in the 48-hours before the start of monitoring. Common adverse reactions to paediatric immunisation include fussing, crying, fever, needle site inflammation and sleepiness (Ministry of Health, 2002b), and the presence of these may influence sleep during the subsequent 24-hours. These reactions may also influence maternal responses to questionnaire items about infants' temperament, health and sleep habits.

Mothers and infants wore the same brand and model of actigraphy based, data-logging device (accelerometer) which was an *Actiwatch®-64* (Mini-Mitter, Oregon, USA) or '*AW64*'. The *AW64* is similar to a wristwatch in size (29 L x 37 W x 12 H, mm) and weighs 16 grams (without a strap or band attached). *Figure 14* shows the *AW64* on a standard, manufacturer supplied wristband, and without a wristband attached.

Figure 14. The Mini Mitter Actiwatch®-64 (sources: www.cpapaustralia.com.au and http://monitorsfamily.respironics.com).

A titanium and polyurethane case houses an accelerometer with sensitivity to motion of less than .01 g-force, and on-board, non-volatile memory of 64 KB. The sensor itself is omnidirectional and it integrates both the intensity and frequency of accelerations to produce an electrical current. An increase in the degree of speed and motion produces a corresponding increase in voltage which is stored as an activity count. The maximum frequency of voltage sampling is 32 Hz. Researchers can set the *AW64* to integrate activity counts across periods of 15, 30, 60 or 120 seconds before data is stored and the counter reset to zero. Another feature of the *AW64* is an event marker button, which can be pressed to time stamp events of interest in the recording, such as lights out or get up times.

Although the sensor is omnidirectional, the shape of it makes it more sensitive to motion changes in particular orientations. For this reason, the manufacturer recommends a standardised placement protocol be developed and adhered to. Primary considerations in developing a standardised protocol for this study were ease of use, safety and comfort. Mothers in the PIPIS Study were given a brief demonstration of *AW64* placement at the prenatal information or education session. During a home visit to set families up for actigraphic monitoring, mothers were given an *AW64* for themselves and their baby, and shown exactly where and how to position the device.

Prior to issue, each actigraph was checked for battery life and batteries were changed if there was less than 100 hours battery life remaining. The *AW64* was then initialised using the manufacturer's *Actiware* software. A sampling period or 'epoch' length of 60 seconds was set, as is commonly used in adult and infant actigraphy studies (So et al., 2007; Tikotzky, Sadeh, & Glickman-Gavrieli, 2010; Tworoger, Davis, Vitiello, Lentz, & McTiernan, 2005) unless the accelerometry data is being compared to another method of sleep/wake assessment, such as PSG or direct observation (Gnidovec, Neubauer, & Zidar, 2002; Lichstein et al., 2006; Sadeh, Acebo, Seifer, Aytur, & Carskadon, 1995).

Parents were advised that the *AW64* only senses movement, that it was not a transmitting or surveillance device of any kind, and that it was also not a device that could detect sound or monitor the breathing activity of their baby. This discussion was considered important, as there is great emphasis in New Zealand on the prevention of sudden unexpected death in infancy (SUDI, Cowan, Pease, & Bennett, 2013) and parents sometimes utilise one or more monitoring devices as part of their own sleep safety regime for their baby.

Mothers were instructed to leave their own and their infant's actigraphs on at all times, except when likely to become wet, such as during bathing. They were requested to press the event marker each time their baby was put down to sleep and again on rising – and if they noticed the infant falling asleep out of bed in places such as a car seat or buggy.

To encourage compliance, several strategies previously used successfully at the Sleep/Wake Research Centre were used as follows:

1. A comprehensive instruction sheet reminding parents of the diary and actigraphy protocol was left at both the 6-week and 12-week home visit.
2. An example of a sleep actogram (output from the monitor) was presented at the study session that all women attended, with an undertaking to send individualised copies of these for the mother and her baby once all data collection was complete.
3. A free telephone number, email address, and direct mobile phone number were left with each participant during the home visit, with strong encouragement to contact the researcher about *any* concerns or questions, anytime from 7 a.m. to 10 p.m., seven days a week.
4. On occasion, to suit a family's schedule, the home visit took place on a day prior to commencement of monitoring. In these instances participants were offered a text message or phone call reminder to start wearing the actigraphs and commence diary logging.

Actigraphs are designed to be worn on the wrist in adults and mothers wore the *AW64* on their non-dominant wrist, in the same fashion as a standard wrist-watch.

Specialised infant actigraph band

In previous studies that have validated actigraphy for the study of infant sleep, the device has been placed on the ankle or calf (Sadeh et al., 1995; So et al., 2005; Tikotzky, De Marcas, et al., 2010). No standard band is available for paediatric use. In a previous study of one-year-old infants conducted at the Sleep/Wake Research Centre, Wellington (Gibson,

2009; Gibson, Elder, & Gander, 2012), a specialised actigraph band was developed for use with older infants. This band provided the starting point for the design of a bespoke band suitable for infants aged up to 12-weeks. Parents attending a community based, postnatal, *Baby & You* parent education course gave consent to have the calf measurement of their 6 to 10 week old infants taken (in the parent's presence). Twelve parents agreed to this process and from these measures three band sizes were created (small, medium and large) ranging from 14 cm to 19 cm in length. The soft, custom-designed band was made from cotton-Lycra®. The band was Velcro™ fastened to allow maximum comfort and adjustability and it fully encased the *AW64* so that no part of the device was in contact with the infant's skin. Figure 15 shows a band before use. The small dot marked the position of the *AW64* event marker, for ease and speed of location.

Two bands were supplied for each 48 hour period of actigraphy, in case one became soiled. Bands were designed to be single-use only and parents were not expected to wash or return them, although they were advised that the bands were fully machine-washable should both bands become heavily soiled. Parents were shown how to insert the *AW64* into the band pocket. They were encouraged to fasten the band as tightly as they felt comfortable, with the goal of reducing the possibility of slippage.

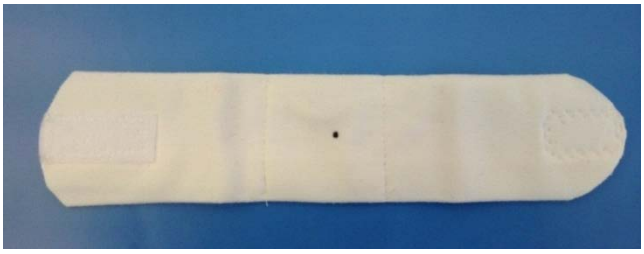

Figure 15. Specialised, early infancy, actigraph band, made from soft, stretch cotton-Lycra® with Velcro™ fasteners. A central pocket encloses the AW64, and the black dot marks the location of the event marker beneath.

The band was worn by infants around the mid-calf, and parents were instructed to position the pocket and *AW64* on the outer calf (see Figure 16). Home visits were timed to coincide as closely as possible with the commencement of the actigraphy recording period and in most instances mothers chose to put their *AW64* and their infant's *AW64* on straight away, while the researcher was still present, meaning any placement and use issues or questions could be addressed immediately. If awake at the time of the home visit, infants were fitted with the correct size actigraph band; otherwise, multiple sizes of bands were left for the mother to assess best fit once her infant awoke.

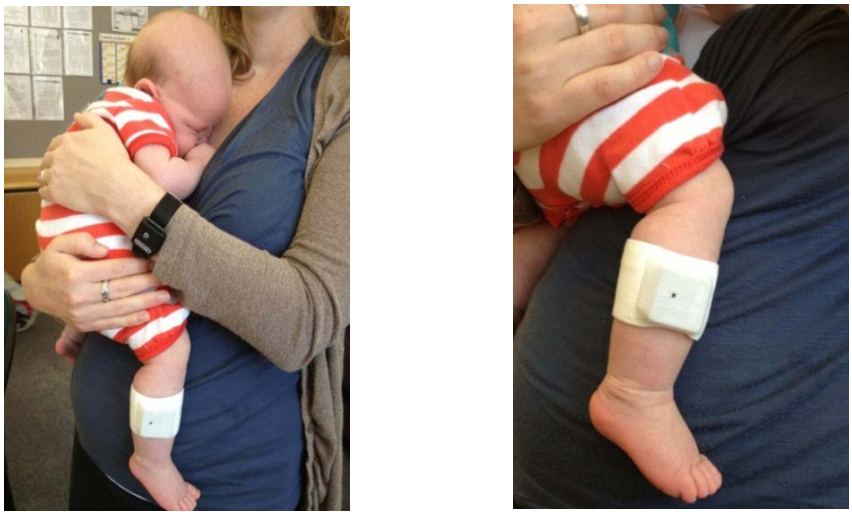

Figure 16. Photo on the left shows volunteer and infant wearing *AW64s* in the correct location and position. Photo on the right shows close up of specialised actigraph band housing an *AW64*, fitted correctly on infant's calf, with event marker (identifiable by the black dot) facing outwards.

Actigraphy scoring

Actiware is a specialised, manufacturer supplied software programme that allows the *AW64* to be configured according to user preferences. *Actiware* also utilises an algorithm which scores all periods of activity (epochs) as either sleep or wake. This is done by comparing activity counts for the epoch in question and those immediately adjacent, to a threshold value set by the researcher. When the activity count exceeds the predetermined threshold, the epoch is scored as wake. If the count is equal to or below the threshold, the epoch is scored as sleep. Activity count thresholds are typically set to low, ≥20 counts of activity per epoch required to score the epoch as wake, medium ≥40 counts per epoch, or high ≥80 counts of activity per epoch required to score the epoch as wake.

Previously, the medium wake sensitivity threshold has been found to achieve the highest agreement (kappa) and the closest estimate of sleep epochs defined by polysomnography in adults (Signal et al., 2005). Infants have been observed to be more active during sleep (Crabtree & Williams, 2009) and for this reason a high wake threshold sensitivity is commonly used to distinguish sleep from waking activity (Gibson et al., 2012; So et al., 2005).

Sleep diaries

Sleep diaries were used to corroborate actigraphy records, as well as to capture additional information mothers may wish to provide such as events of note during the actigraphy period and whether sleep periods included external motion such as car journeys. Each mother completed separate sleep diaries for herself and her infant (Appendix 17) as part of the 6-week and 12-week actigraphy study. Diaries consisted of a 24-hour (midday-to-midday) timeline onto which mothers marked the beginning and end

of sleep periods, each feeding episode (infant diary), and times when the watch was removed, for instance for bathing. Mothers also completed a Stanford Sleepiness Scale before and after each main night sleep period, and noted the locations their baby slept during the night on the infant diary. Mothers were shown how to complete the diary at the information or education session attended in late pregnancy, and again when actigraphs were delivered to her home by the researcher. Full written instructions were also provided (Appendix 18) as well as contact details of the researcher. It was emphasised on several occasions that mothers should feel free to contact the researcher at any time if they had *any* concerns or queries about the data collection processes or equipment.

Feedback

Once data collection was complete for each woman, she was sent a letter advising that the study had been a trial and which group she had been assigned to. Each woman was also sent all of the materials her alternate group had received and she was given the opportunity to receive the session (information only or education) that she had missed out on. Two control group women took up the opportunity to receive the sleep education session and these took place in their own homes, with their partner present. A final questionnaire was included with this 'reveal' letter. The questionnaire sought feedback on the experience of participating in the study (see Appendix 19) and contained a post-intervention measure of maternal self-efficacy in relation to infant sleep.

After all actigraphy data had been visually scored and double-scored, women were sent annotated actograms of their sleep and their infant's sleep from the 6-week and 12-week monitoring periods.

Defining objective sleep variables

Actigraphy data were corroborated with a sleep diary for each 48 hour period of monitoring. *Night* was defined as 21:00 – 09:00 hours, following the work of Stremler et al. (2006). The objective sleep variables described in the following sections were generated in order to determine differences (between groups and within groups over time) for sleep duration and sleep quality. Data generated by the *Actiware* software were manipulated in two ways. A custom developed software programme using MATLAB® 7.5 was used to calculate variables summed for 24 hours. Variables which were summed for 12 hours (21:00-09:00 night, 09:00-21:00 day) were manually calculated in Microsoft Office Excel™ (2007 version), and double-scored to ensure accuracy.

Meltzer et al. (2012) recently published guidelines on reporting the use of actigraphy in paediatric sleep research. These guidelines were published after data collection was complete but, where possible, they have been adhered to in this chapter.

Objective sleep duration

All objective sleep duration variables are reported in minutes. Guidelines for visual scoring of actigraphy data can be found in Appendix 20.

Time in bed (TIB)

This variable describes sleep opportunity and was derived from the time of attempting to initiate sleep (sleep start time) to the time of ending a sleep episode (sleep end time), as indicated by sleep diary, event marker and/or change in activity.

Total sleep time (TST)

This was the amount of time activity levels fell below the sensitivity threshold for wakefulness during a specified TIB interval. First the difference between sleep start and sleep end time was calculated in minutes, this is known as 'assumed sleep time' or 'sleep period'. Then any actigraphically determined awake time during the interval is deducted from the total. The remainder is known as 'actual sleep time' or TST.

Nocturnal TST

This was the amount of TST that fell during defined *night* (21:00 to 09:00 hours). The nocturnal TST calculation contained only minutes of sleep that actually fell in the defined *night* period. When a sleep period commenced before 21:00 or ended after 09:00, a new variable was created by deducting sleep in minutes before/after the nocturnal cut-off times, after adjusting the number of minutes for the overall percentage of awake time during the whole period. Table 28 shows a worked example of a mother whose first night-sleep period began at 8:28 p.m. and ended at 2:29 a.m. During this period the sleep/wake ratio was 86.43%. Looking at the 'Sleep start_time', it can be seen that 32 minutes of the sleep period occurred before *night* (21:00:00) so these minutes were deducted from the original total sleep period, to give an adjusted nocturnal sleep period of 329 minutes. This sleep period was then multiplied by 86.43% to give an adjusted nocturnal TST of 284 minutes.

Table 28
Example of calculations to adjust truncated nocturnal actual sleep time for minutes of sleep which fall outside of the defined night period

Actigraphy end date	Sleep start time	Sleep end time	Sleep period	Awake time	Percent sleep		Total sleep time
19/07/11	20:28:00 [a]	2:29:00	361	49	86.43		312
Adjusted sleep duration	21:00:00 [b]	2:29:00	329 [b]	×	86.43	=	284

Note: [a]Actual sleep period starts before defined night. [b]Only duration of sleep occurring after the defined night start time of 21:00 hours is included in the calculation.

Longest nocturnal sleep

Longest nocturnal sleep was the maximum period of nocturnal total sleep time as calculated using the method just described.

Number of night time awakenings (infants)

The frequency of infant awakenings was calculated as the total number of rest episodes during defined *night*, minus one.

Nocturnal total rest time (infants)

This was calculated in the same way as nocturnal TST but was based on TIB rather than sleep period.

Longest nocturnal rest period (infants)

Longest nocturnal rest period was the maximum longest period of nocturnal rest time in the 48-hour period.

Objective sleep quality

Nocturnal Sleep efficiency

Sleep efficiency was determined from actigraphy data. This variable represents TIB divided by TST during a specified interval, multiplied by 100 (expressed as percent). Sleep efficiency gives a general sense of how well an individual slept. No inferences can be drawn as to the cause of reduced sleep efficiency percentages, which could include a long sleep latency period, a long sleep offset period (waking but not moving), a number of brief awakenings or an extended period or periods of waking during the sleep episode (Pressman, 2002). In almost all cases, multiple sleep periods occurred during *night*. Sleep efficiencies for sleep periods at *night* were therefore combined and converted into a single

average, weighted by duration, for each of the two study nights. The two nights were then averaged to give a single sleep efficiency variable for each mother for analysis.

Defining subjective sleep variables

Subjective sleep duration

Total sleep time

Self-reported total sleep time was reported for multiple occasions. In the Sleep and Health during Pregnancy Questionnaire participants reported their usual total sleep time in 24-hours before this pregnancy, and currently, at 35–37 weeks gestation. Usual total sleep time in 24 hours was also reported in the Postpartum Sleep and Health Questionnaire at 12-weeks postpartum. Total sleep time reports in telephone interviews were for the previous 24 hours. Subjective total sleep time was reported by participants in hours and fractions of hours.

Subjective sleep quality

Sleep problem

At 6-weeks and 12-weeks postpartum a single item question from the Brief Infant Sleep Questionnaire (Sadeh, 2004) was used to assess if mothers considered their infant's sleep to be a problem. Women could choose from one of three response options—*a very serious problem*, *a small problem* or *no problem at all.* The same question was used to ask women if they considered their own sleep to be a problem.

Good night's sleep

A single item question from the 2007 Sleep in America Poll on women (National Sleep Foundation, 2007) was used to determine on how many nights per week each woman thought she experienced a good night's sleep. Getting a good night's sleep was measured retrospectively for pre-pregnancy sleep, and prospectively at 35–37 weeks gestation and at 12-weeks postpartum.

General Sleep Disturbance Scale

Psychometric properties of the GSDS are described on page 73 (Study One Methods). Participants completed the GSDS at 35–37 weeks gestation and at 6-weeks and 12-weeks postpartum.

Data management and analysis

Questionnaire data

A number of databases were created during this study as a result of employing multiple measurement methods and instruments. Data from the Sleep and Health during Pregnancy and Postnatal Sleep and Health questionnaires were double-entered using Epi Info (Version 3.5.1) [Computer software]. Retrieved from http://wwwn.cdc.gov/epiinfo/. The two databases were compared using the compare procedure of SAS (Version 9.1). Discrepancies were checked against the original questionnaire and one, final, corrected file was used for all analyses.

PIPIS questionnaire data were double-entered into custom designed databases created in Microsoft Access (2007 version), after which both databases were visually proof read and compared for errors and omissions. Corrections were made to one master copy of each database after cross-referencing back to original questionnaires.

Actigraphy data

As soon as *AW64s* were collected from participants, data were downloaded using the manufacturer's software—*Actiware* (Version 5) [Computer software], Bend, OR: Respironics Mini Mitter. Individual participant's data may be viewed in the form of an actogram (see Figure 17) which allows manual, visual scoring of rest/activity intervals.

As seen in Figure 17, the actogram was displayed from midday to midday. Black vertical lines underscored by a horizontal red line represent activity counts. Periods containing few black vertical lines reflect times of rest or times when the monitor has been removed. Small triangles at the top of each day's activity mark when the event marker was pressed by the mother when she started trying to sleep and when she finished. The period shaded in blue highlights the duration of the rest interval which is manually set by the scorer based on interpretation of diary entries, event marker used and change in activity as seen in the actogram. The darker of the blue shading denotes the period in which sleep has occurred, as defined by the *Actiware* algorithm. Lighter blue shading at either end of the rest interval indicates the duration of sleep onset and snooze time after waking within the same rest interval.

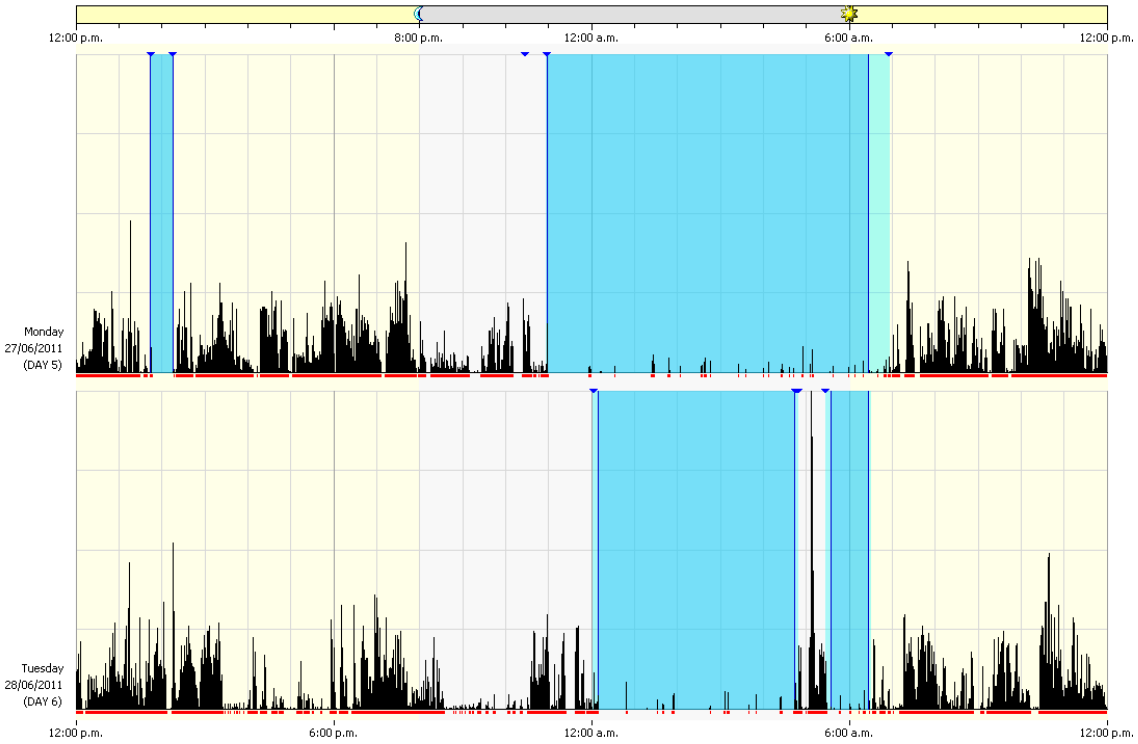

Figure 17. Example of 48-hours of continuous actigraphy recording from a participating mother at 12-weeks postpartum.

Determination of sleep and wake

To score an epoch as sleep or wake, the software evaluates the epoch in question and weighted fractions from the two epochs either side of a central epoch. Figure 18 illustrates the fraction of activity counts from each epoch included when 1 minute sampling epochs are used. The percentage contribution of all five epochs is summed and if this weighted activity level is above the pre-set threshold, the central epoch is scored as wake. If the weighted activity level is below the pre-set threshold, the central epoch is scored as sleep. In this study the pre-set activity thresholds were 40 activity counts per minute for mothers and 80 activity counts per minute for infants.

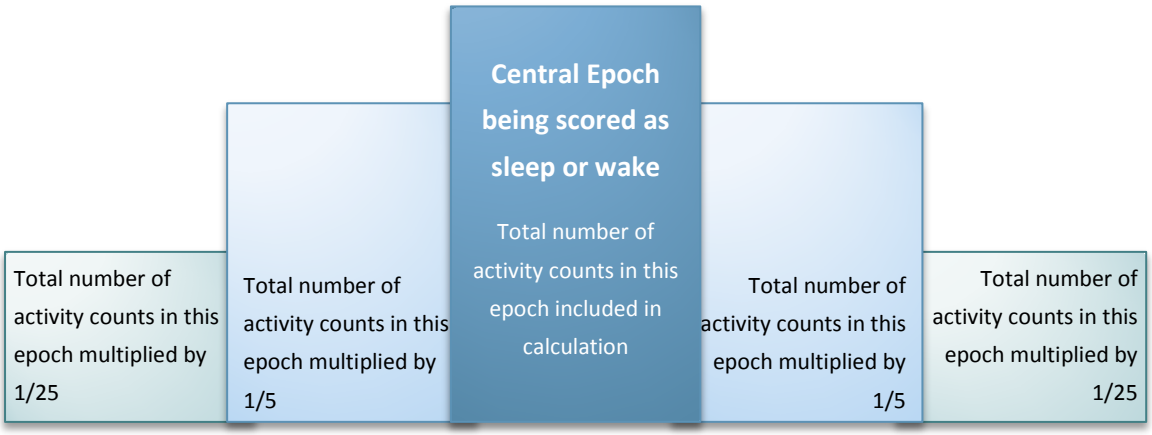

Figure 18. Graphical representation of the *Actiware* algorithm showing proportions of surrounding activity value counts included when calculating the sum of activity counts for a 1-minute sampling epoch, in order for the epoch being evaluated to be scored as sleep or wake (adapted from *Actiware* Software, Version 5.0, Actiwatch Instruction Manual, 2009, Respironics, Bend, OR).

Double-scoring agreement

Twenty percent of actigraphy files were randomly chosen for double-scoring. Eight participant ID numbers were selected by using the Microsoft Excel RAND function. Mother and infant raw *Actiware* files were separately scored by an experienced, independent assessor. A two-step process was used when there was disagreement of greater than 15 minutes between scorers. First, a cross-check was made with the original diary (time log and notes) and the raw actigraphy file for accuracy and to consider interpretation and application of the actigraphy scoring guidelines. If this did not provide resolution, a neutral, third experienced assessor was consulted. An agreement rate of 80% or higher has been suggested by Berger et al. (2007).

Infant sleep parameter

Actigraphy has been reported in the literature as valid for use with young infants, and is indicated for use by the 2007 American Academy of Sleep Medicine (AASM) parameters which state that, "*Actigraphy is indicated for delineating sleep patterns, and to document treatment responses in normal infants and children (in whom traditional sleep monitoring by polysomnography can be difficult to perform and/or interpret), and in special pediatric populations*" (Morgenthaler et al., 2007). An earlier AASM review noted an increase in the use of actigraphy when studying sleep in children, but also cautioned about the lack of technical details in published studies (Ancoli-Israel et al., 2003). Ten years on and a recent review of the use of actigraphy in paediatric research reported similar issues (Meltzer et al., 2012) . So, whilst actigraphy continues to grow in popularity, a lack of

guidance still exists in the form of practice standards or consistency in technical, scoring and reporting guidelines.

Challenges in using actigraphy in very young infants include artefact from external motion (Tsai et al., 2009) and higher levels of activity and arousals during sleep that are associated with normal early infant neurological development (Grigg-Damberger et al., 2007) compared to those seen in older populations. The present study was not immune to these challenges, and after data collection and initial visual screening of actograms, reliability of the classification of sleep by *Actiware* became a concern. Figure 19 shows an actogram for a 6 week old infant who appears to be an 'active baby'. The *AW64* detected activity in this infant across the entire 48 hour period, with activity counts sufficiently high to be scored as waking more often than sleeping behaviour, even during diary defined sleep periods. Total time in bed was determined as 828 minutes on day 1 and 783 minutes on day 2. Total sleep time was determined as 214 minutes on day 1 and 105 minutes on day 2.

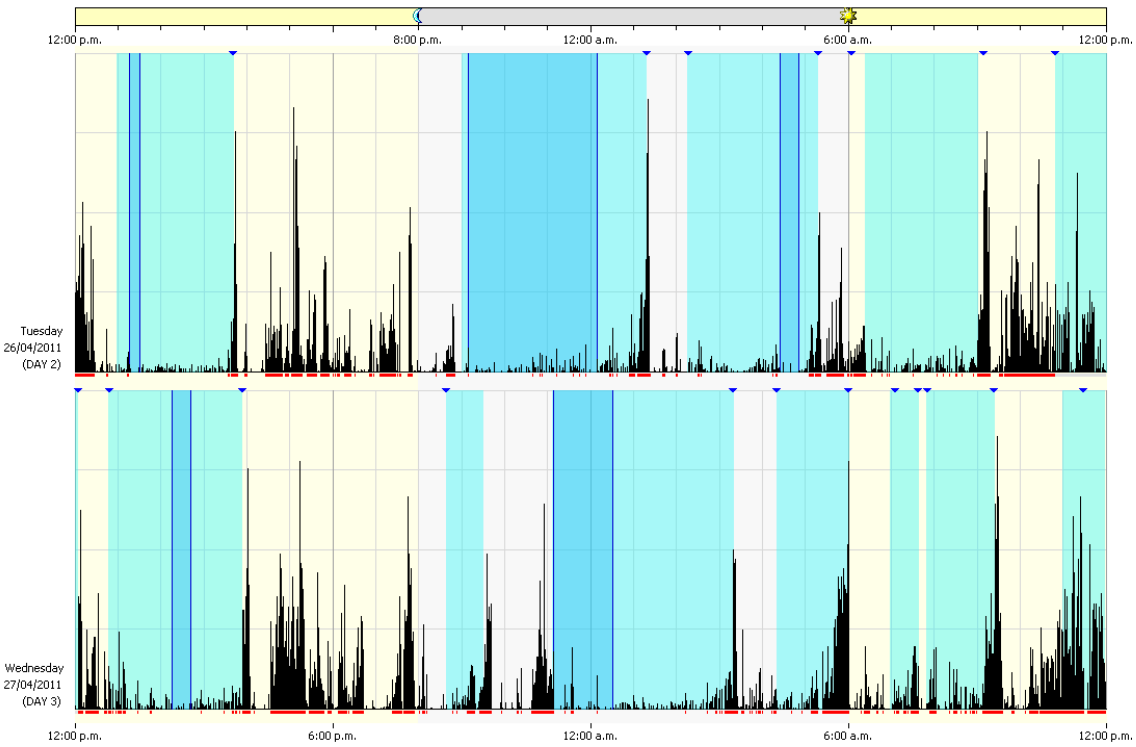

Figure 19. Actogram of 6-week old infant. Pale blue shading indicates time in bed as defined by event marker and corroborated by sleep diary. In the absence of an event marker, diary entry and/or a change in activity level was used to determine interval times.

In other instances, periods of sleep were logged in the infant's sleep diary along with comments about external motion such as "in buggy walking", "in car". Although there is a setting to visually mark 'forced sleep intervals' in *Actiware,* the duration of the forced sleep interval is not reflected in the TST variable. For these reasons the decision was made to only use rest duration (TIB) as the main parameter for infant analyses.

Assumption checks

Data were screened using both statistical and graphical methods according to the checklist for screening data described by Tabachnick and Fidell (2013). Accuracy of data input was assessed by inspection of univariate descriptive statistics to detect out-of-range values, plausible means and standard deviations and univariate outliers.

All databases were inspected to gauge the amount and pattern of missing data. The amount of missing data was minimal (less than 2%). In analyses using the GSDS, one case was deleted because of the amount of missing data in that scale (6 of 18 items).

Following these processes of data cleaning and verification, descriptive statistics were produced (mean, standard deviation, minimum-maximum) for each variable of interest and checked for plausible values. Descriptive statistics were generated using SPSS (Version 19). Shapiro-Wilk analysis of normality was used to assess all variables of interest. The Shapiro-Wilk statistic is used to assess if the distribution of scores differs significantly from a sample with normal score distribution and this test is considered appropriate to use with small samples (Field, 2009). Descriptive data is reported as the mean and standard deviation when distribution was normal, otherwise it is reported as median and range, and non-parametric univariate tests were used. For all tests, a p value of .05 (or less) was considered to be statistically significant. Each area of analysis is described below.

Mixed Model Analysis

Generalised linear mixed effects models ('mixed models') were utilised to determine if sleep duration and sleep quality differed significantly between the intervention group and the control group. Mixed models are suitable for use in longitudinal studies, where measures are repeated on the same individuals and responses from the same subject over time are assumed to be correlated. Unless the particular sample of individuals are the specific interest of a study, as opposed to the interest being to generalise to a wider population, then individual subjects introduce undesirable variability or 'random' effects into any model used. Mixed models give greater control over this variability, and within

subject correlation, by allowing the researcher to specify the individual as a random effect, and the actual variables of interest as fixed effects.

Consideration of prenatal data

As part of the PIPIS intervention, women attended either the general information session (control group) or sleep education session (intervention group) in late pregnancy. A goal of the study was to run the session as close as possible to the end of pregnancy, whilst avoiding attrition because of birth (given the unpredictability of the exact date of most births). By the very nature of the reproductive process, gestational dates for women in each session were all different, although within a few weeks of each other. This meant that by the time they attended a session, some women had completed the 35–37 week questionnaire and others were yet to reach that point in their pregnancy. Therefore, even women in the control group had experienced exposure to the topic of sleep. It was hypothesised that any exposure to the topic of sleep at a study session could have influenced reporting of subjective sleep information. It was also hypothesised that the effect should be minimal for a number of reasons. Firstly, the general sleep information presented to the control group was considered basic in nature and commonly available in the public domain, such as women's magazines or health and lifestyle sections of print or online media—it was unlikely to be new information. Secondly, the detailed information and recommended behavioural practices presented to the sleep intervention group pertained to postpartum sleep (not current sleep in pregnancy). Finally, the session was only one part of the total sleep intervention, with much of the intervention occurring after birth, through the support and problem solving telephone calls. Qualitative feedback from control group participants, about the information session they attended, supported the hypothesis of minimal effect:

"Was pretty basic stuff focused on your sleep." (ID 7130)

"Didn't find the information particularly different or new to other sources." (ID7516)

"I can't really remember it." (ID7514).

To ensure that this was the case, the two groups were compared for differences between mothers who had, or who had not, attended a session at the point they completed the questionnaire, before inclusion in mixed models. Three variables of interest (Total subjective sleep time in 24 hours, GSDS and good night's sleep) were tested in this way using ANOVA and no statistically significant differences were found between women who had completed the 35–37 week questionnaire and those who had not, at the time of attending a study session (see Table 29). Based on this finding, the 35–37 week data were included in relevant mixed models.

Table 29
Results of ANOVA comparing sleep related variables between women who completed 35–37 week questionnaires before or after attending a study session, by group

Dependent variables	Fixed Factors[a]	Statistic
TST_{subj} 24-hours	Group, Completion	$F(3), = .1, p = .96$
GSDS	Group, Completion	$F(3), = .04, p = .99$
GNS	Group, Completion	$F(3), = .6, p = .62$

Note. a Group = sleep intervention or control. Completion = completed 35-37 week questionnaire before or after attending a study session.

The mixed model procedure

A consistent process was followed in completing the mixed model analyses. Littell and colleagues describe two main steps in performing a repeated measures analysis using mixed model methodology (Littell, Henry, & Ammerman, 1998). First, observations for the same individual are expected to be correlated so a covariance structure must be modelled. Second, time trends for the intervention can be analysed by estimating and comparing means.

Whenever the mixed model procedure is being used for repeated measures analysis, it is strongly recommended that a suitable correction be applied to estimating denominator degrees of freedom (Littell, Milliken, Stroup, Wolfinger, & Schnabenberger, 2006). This is because the risk of making a Type I error tends to increase, that is, incorrectly concluding that there is a reliable difference by failing to reject the null hypothesis when it is true (Spicer, 2005), especially when using complex covariance structures. The Kenward-Roger correction is recommended for mixed models for repeated measures, and when data are unbalanced (that is with missing observations; Littell et al., 2006). It is also suitable for use with most covariance structures and was therefore employed in all mixed effects models.

In models including repeated measure data from only two time points, in this case the postnatal models, the compound symmetry covariance structure was applied. In models including repeated measure data from more than two time points, other covariance structures were evaluated based on Schwarz Bayesian Criteria, represented by the Bayesian Information Criterion or BIC value produced. In SAS the model with the smaller BIC indicates better fit. The procedure used for evaluating other covariance structures is described below. Ultimately, all analyses were modelled using the compound symmetry covariance structure.

Consideration of other covariance structures

A number of models included measures repeated on more than two occasions. The most complex of these had maternal self-reported total sleep time in 24 hours as the outcome variable. Self-reported sleep duration was included in the model from prior to pregnancy, at 35–37 weeks gestation, and at 2, 4, and 12 weeks postpartum. These time points were unequally spaced and this limited the available choices of covariance structure, since most assume equal spacing of repeated measures.

In order to specify the covariance structure for this mixed model, a procedure known as 'unstructured' was applied first—Model 1. This structure is considered the most "liberal" because it makes no assumptions regarding equal variances or covariances (Kincaid, 2005). It also requires fitting the most parameters of any covariance structure. Limitations on the computational capacity to calculate such a structure could make it impossible to run the model in this way (Littell et al., 1998), however this posed no issue in the present study.

Values produced by Model 1 were then used to create 'lag plots'. Lag plots allow graphical inspection of estimated covariance parameters, for one subject, over the number of times data were observed. Lag plots for Model 1 and values from the correlation matrix of Model 1 were assessed and suggested either the use of the compound symmetry covariance structure or the spatial power covariance structure (both of which can account for the uneven periods of time between data observations). A model was therefore run using each of these structures and Schwarz Bayesian Criteria (represented by the BIC value produced by SAS 9.3) were compared to objectively assess the model of better fit. This approach adjusts the REML log likelihood value by imposing a penalty based on the number of parameters in the model (Littell et al., 1998). The compound symmetry covariance structure provided the best fit and was applied as outlined below.

The compound symmetry covariance structure assumes that, regardless of the proximity of time, measures at all times have the same variance, and all pairs of measures on the same individual have the same correlation (Littell, Henry & Ammerman, 1998; Liu, Rovine & Molenaar, 2012). This implies that the only aspect of covariance between repeated measures is due to individual contribution, regardless of time point.

For each dependent variable of interest, a full model was first run including all fixed and random effect factors, as specified for each model of interest. Full models also specified a number of interaction effects. An assumption of the model is that residuals are normally distributed and that they have a constant variance. This was checked by examining residual box plots, histograms and Shapiro-Wilk normality test results. Outliers were evaluated and removed before running the model again. If the outliers altered the

findings of the model, then the reported results exclude the outliers. If exclusion did not alter the findings, the results include the outliers.

Output was generated for tests for all fixed effects specified in the model (similar to univariate ANOVA F-tests) and these were inspected for significance. When interaction effects were not statistically significant, these were removed from the model in a stepped fashion, starting with the interaction of least significance (the largest '*p*' value), and the model was re-run. When main and interaction effects were statistically significant, post-hoc *t*-tests were used to explore relationships of interest. Holm's sequentially rejective procedure was applied in these analyses to adjust for multiple pairwise comparisons (Holm, 1979). This is considered a conservative approach, but more powerful than other family-wise error corrective tests such as the Bonferroni procedure (Aicken & Gensler, 1996).

Each model included the same fixed effects of intervention condition (group) and timing of data collection (time). Infant sleep location (location) at night was included in a number of mixed models, and the rationale for this is described on page 170. Participant identification number (ID) was included as a random effect. A number of other variables were considered for potential inclusion in the model and these were evaluated on the grounds of theoretical relevance to the model as follows.

Maternal age

Sleep duration is known to change across the lifespan (see Figure 20). Participants ranged in age from 28 to 39 years and during this period of the lifespan sleep architecture and total sleep duration are expected to remain stable (Ohayon et al., 2004). For this reason maternal age was not included in the final models.

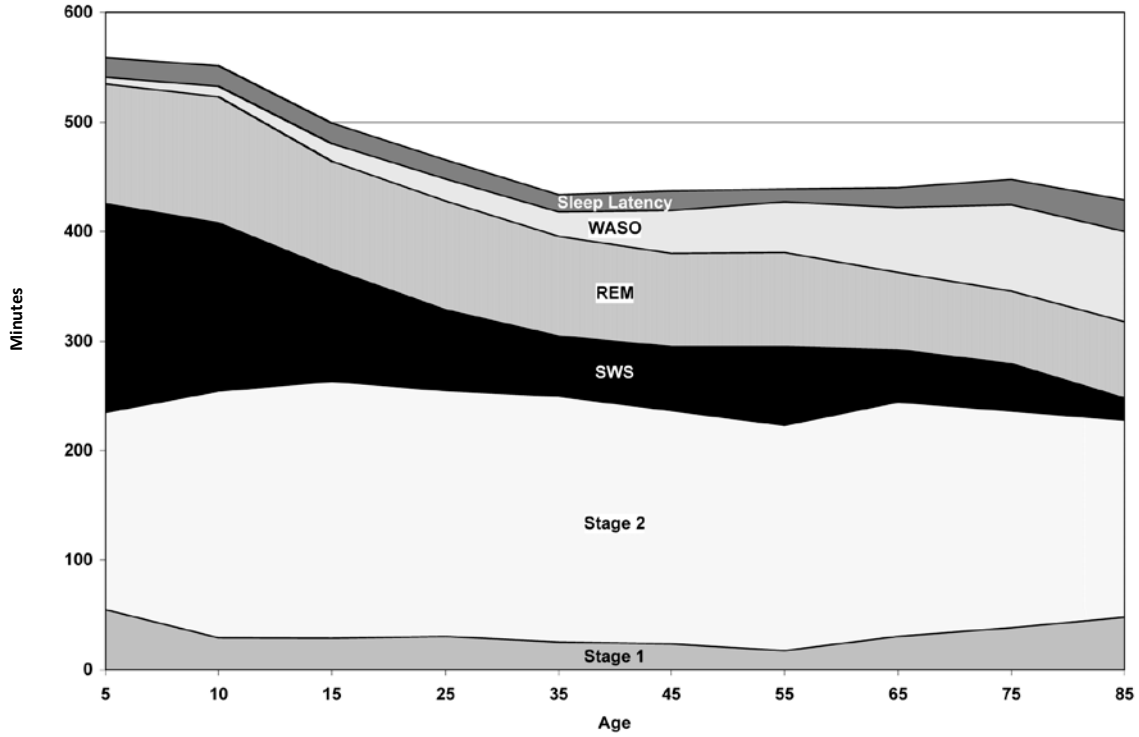

Figure 20. Age-related trends for stage 1 sleep, stage 2 sleep, slow wave sleep (SWS), rapid eye movement (REM) sleep, wake after sleep onset (WASO) and sleep latency (in minutes). (Ohayon et al., 2004)

Breastfeeding status

The role of breastfeeding in night-time sleep duration is equivocal. Breastfeeding is often linked with more frequent sleep disturbance for both mothers and infants than feeding with artificial infant formula, as human breastmilk is more readily digestible by the infant who may then wake more frequently after gastric emptying (Mindell & Owens, 2010; Sadeh et al., 2010). However, in a study of infants similar in age to the PIPIS Study infants (2 to 12 weeks old), no significant differences were found in the sleep of women between those who exclusively breastfed, exclusively formula fed or fed by a combination of both methods (Montgomery-Downs, Clawges, & Santy, 2010). Breastfeeding status was originally considered for inclusion in these mixed models as frequent sleep disturbance to feed their infants (greater than or equal to 3 nights per week) was noted by 80% of control group and 75% of intervention group mothers at 12-weeks postpartum (see Figure 21). Since there was little between-groups difference in breastfeeding status, and the number of women who were formula feeding were so small, it was not included in any final models.

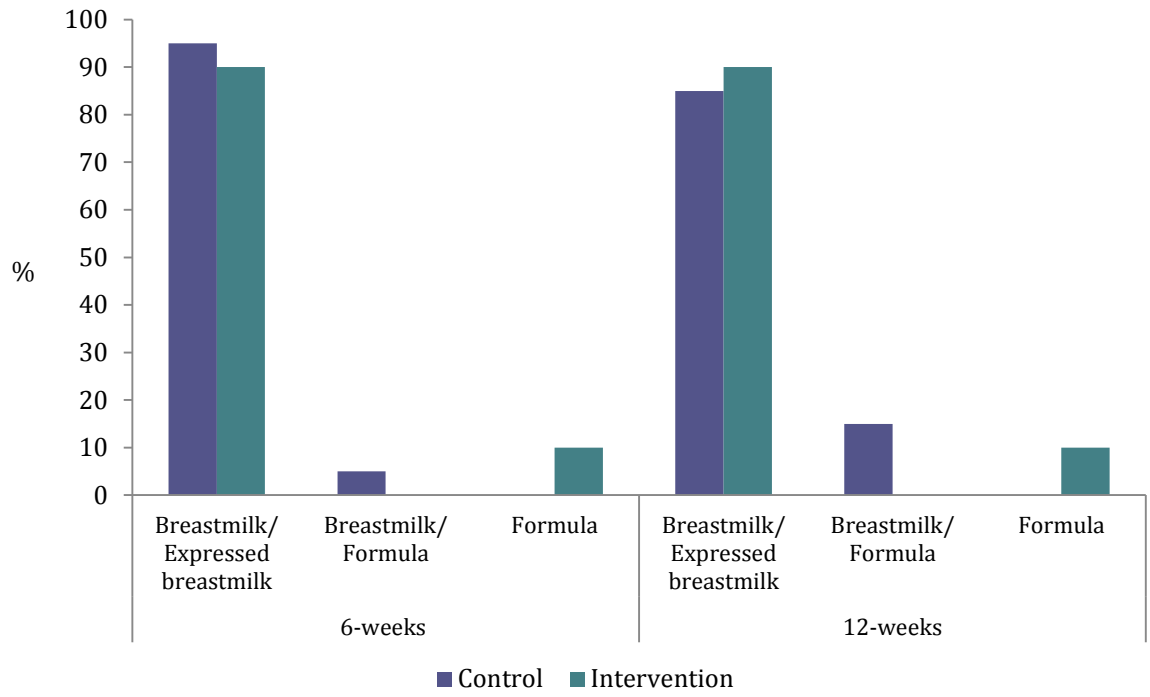

Figure 21. Infant feeding status at 6-weeks and 12-weeks postpartum.

Infant sleep location

It is widely accepted that infant sleep impacts maternal sleep. There is, however, little in the literature describing the impact on maternal sleep duration when infants sleep in varying locations, apart from literature concerning infant bed-sharing practices. Infants who sleep in their own bed that is in their own room may have fewer awakenings at night and be more likely to sleep through the night. (Sadeh, 2004; Sadeh, Mindell, Luedtke, & Wiegand, 2008). The impact of these findings on maternal sleep can be inferred.

To test if location of infant sleep at night was having any impact on maternal sleep duration, maternal total sleep time in 24-hours was compared by infant night sleep location for each group using Student's t-tests (see Table 30). When infants slept in their own room at night, control mothers obtained significantly more sleep than intervention mothers (on average 79 minutes). Intervention group mothers slept significantly longer (on average 58 minutes) when infants slept in the parent's room rather than in their own room at night. Based on these within group and between group findings, infant sleep location was included as a fixed effect in all mixed models where infant sleep location applied.

Table 30
Differences in maternal total sleep time by location of infant sleep at night (minutes)

	Intervention group	Control group	Between-group Difference	*t*	DF	*p*
Infant in parents' room	413	399	14	-0.682	23	.502
Infant out of parents' room	355	434	79	2.98	13	**.011**
Within-group differences						
Intervention group	58			-2.513	18	**.022**
Control group		35		1.430	18	.170

Note. Boldface is significant at $p = .05$.

Chapter Six

Study Two—The PIPIS Study

Results

This section begins with a description of participants in the PIPIS study. Data from 40 mother-infant pairs were analysed, with 20 pairs each in a control group and an intervention group. Four main hypotheses (restated below from Chapter One) were tested in relation to the primary study question, and findings related to these are presented next, starting with outcomes relating to maternal sleep, followed by outcomes relating to infant sleep. Acceptability of the tasks, processes and content of the PIPIS Study follow the sleep related results.

Hypotheses for the PIPIS study were:

1. Maternal sleep duration: Mothers in the sleep intervention group will obtain more sleep in a 24 hour period, at 6-weeks and 12-weeks postpartum, compared to mothers in the control group.
2. Maternal sleep quality: Mothers in the sleep intervention group will report better sleep quality and fewer sleep problems, at 6-weeks and 12-weeks postpartum, when compared to mothers in the control group.
3. Mothers in the sleep intervention group will report higher levels of confidence about managing their infant's sleep at 12-weeks postpartum, compared to mothers in the control group.
4. Infant night time awakenings: Infants in the sleep intervention group will have fewer night time awakenings at 6-weeks and 12-weeks postpartum.
5. Infant night rest duration: Infants in the sleep intervention group will have longer maximum night time rest periods at 6-weeks and 12-weeks postpartum.

Description of PIPIS participants

Ethnicity

Totals exceed 40 as participants could choose to identify with more than one ethnicity. The majority of women in the PIPIS Study identified as New Zealand European (n = 33), with Māori, British, Chinese, Indian, Italian and Middle Eastern ethnicities

selected by a small proportion. Thirty-nine infants were identified as New Zealand European and a small proportion of mothers also selected British, Chinese, Indian, Māori, Middle Eastern, Welsh or other unspecified for their infant's ethnicity.

Maternal age

Maternal age was recorded as at 35–37 weeks gestation. Participants' age ranged from 28 to 39 years. Maternal age did not differ significantly between the two groups, $t(38) = -0.858$, $p = .397$. The average age of intervention group mothers was 33.7 years ($SD = 2.94$), and the average age of control group mothers was 32.9 years ($SD = 2.76$).

Socio-economic status

Two measures were used as indicators of socio-economic status—NZDep06 and self-reported annual combined household income.

There was no difference between the control group and the intervention group in the distribution of levels of socio-economic deprivation, as measured by the NZDep06 index, $U = 151$, $z = -1.34$, $p = .179$. Figure 22 shows the percentage of women living in each of the NZDep06 area deciles, at 12-weeks postpartum.

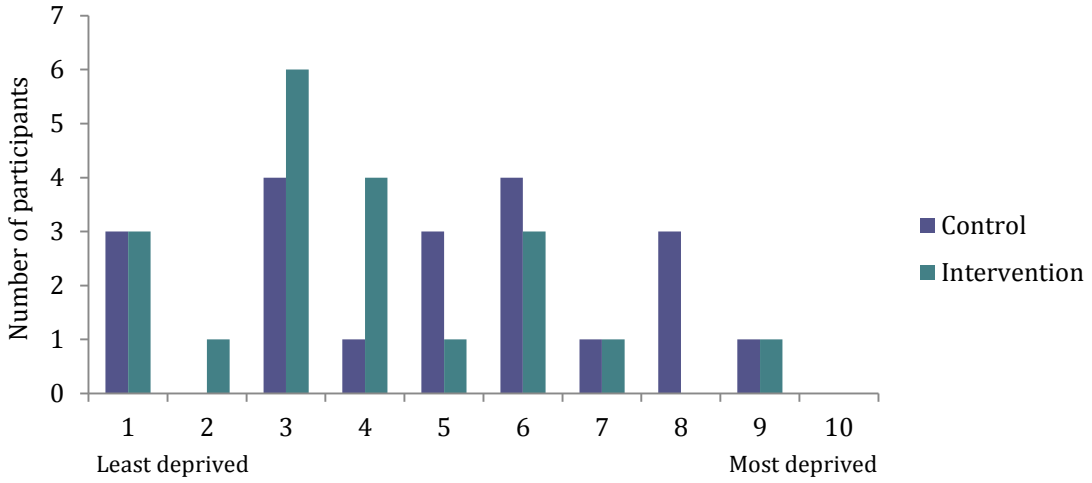

Figure 22. Distribution of participants across NZDep06 area indices.

In this study, the combined household income for all but one woman was greater than $70,000 for the twelve months prior to questionnaire completion, at 12-weeks postpartum (see Table 31). More than three-quarters of women (77.5%) had combined household income levels equal to, or greater than, $100,000 in the previous twelve months. There was no statistically significant difference in the distribution of income between the intervention or control group, $\chi^2(3) = 2.49$, $p = .478$.

Work status

At 35–37 weeks gestation, most women were still participating in work for pay, profit or income (see Table 31). Hours worked by intervention group women ranged from 36 to 50 hours per week (mean 40 hours, *SD* = 2.67). Hours worked by control group women ranged from 15 to 50 hours per week (mean 38 hours, *SD* = 7.18). No women reported any work at night (during the hours of midnight and 5 a.m.).

Despite one of the selection criteria being that women plan to provide full-time care to their baby for at least the first 12 weeks after birth, three women (one intervention group and two control group) found it necessary to return to part-time or casual employment in the week or two prior to completion of the Postnatal Sleep and Health questionnaire. Another control group mother was returning to work on the day after Postnatal Sleep and Health questionnaire completion. The majority (75%) of women were taking paid parental leave at 12-weeks postpartum, and almost all were planning to return to paid work even if they currently had no set plan as to when that would be (see Table 32). Participants were not asked if they were already taking paid parental leave during pregnancy.

Table 31
Work status and income in late pregnancy and at 12-weeks postpartum

	35–37 weeks gestation		12-weeks postpartum	
	Intervention	Control	Intervention	Control
Currently working				
No	3	1	19	18
Yes – one job	16	18	1	2
Yes – more than one job	1	1	0	0
Income				
25,000–30,000	-	1	-	-
35,001–40,000	-	-	-	1
70,001–100,000	-	3	2	4
100,000–150,000	10	4	7	4
>150,000	10	12	10	10
Missing	-	-	1	1

Table 32
Parental leave

	35–37 weeks gestation		12-weeks postpartum	
	Intervention *N*	Control *N*	Intervention *N*	Control *N*
On Paid Parental Leave			15	15
Plans to return to work				
No plans	2	0	4[a]	0
Plans, no date	4	5	3	3
Plans, set date	14	15	13	15
Returned to work	0	0	0	2
Plan to return to work, infant age				
3-6 months			6	4
7-9 months			3	1
10-12 months			3	10
>12 months			1	1

Note: [a]One woman returned to casual work in a family business, but had no plans to return to her usual professional role.

Partner relationship

Participants reported on two occasions how happy their partner relationship was at that time. This scale was collapsed into three categories and Figure 23 shows the proportion of women in each group, by category.

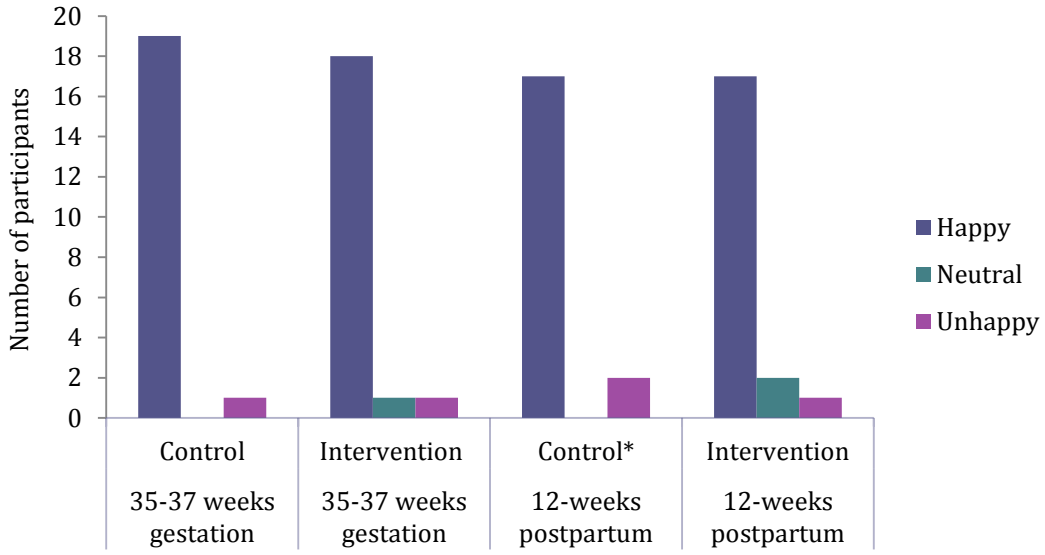

Figure 23. Happiness in partner relationship in late pregnancy and at three months postpartum, * *n* = 19.

Depression symptoms

The number of women reporting symptoms of major depression, using the full 10-item EPDS, and symptoms of minor depression, using the brief EPDS-3A, are reported in Table 33. There was no difference in total EPDS scores between the control or intervention groups in late pregnancy, U = 163, z = -1.00, p = .315, at 6-weeks postpartum, U = 153.5, z = -1.27, p = .205, or at 12-weeks postpartum, U = 219.5, z = 0.530, p = .596.

Table 33
Women meeting criteria for symptoms of minor or major depression

	35–37 week gestation		6-weeks postpartum		12-weeks postpartum	
	Intervention *N (%)*	Control *N (%)*	Intervention *N (%)*	Control *N (%)*	Intervention *N (%)*	Control *N (%)*
Full EPDS						
EPDS >9	5 (25)	8 (40)	0 (0)	4 (20)	2 (10)	4 (20)
EPDS >12	2 (10)	0 (0)	0 (0)	1 (5)	0 (0)	2 (10)
EPDS-3A						
EPDS-3A >9	5 (25)	12 (60)	4 (20)	6 (30)	4 (20)	3 (15)
EPDS-3A>12	2 (10)	2 (10)	1 (5)	2 (10)	1 (5)	1 (5)

Note. *Probable minor depression based on an EPDS score >9, and probable major depression based on an EPDS score >12.*

Mode of birth

Birth experiences were similar for the two groups. Five intervention group and six control group women had normal vaginal births. Nine intervention group and 10 control group women gave birth vaginally with some form of medical intervention such as induction of labour or instrumental delivery. None of the women had been scheduled for a planned caesarean section. Six intervention group and four control group women had unplanned caesarean sections.

Infant gestational age at birth

For intervention group infants, mean gestational age at birth was 39.3 weeks (*SD* = 1.7, range 35 to 41 weeks). Mean gestational age at birth of control group infants was 39.8 weeks (*SD* = 1.2, range 36 to 42 weeks). The American Academy of Pediatrics (AAP), American College of Obstetricians and Gynecologists (ACOG) and the National Center for Health Statistics (NCHS) define infants as being "late preterm" when birth occurs between 34 weeks and 36 weeks 6 days (Engle, Tomashek, & Wallman, 2007). One infant in each group was born late preterm. Both were born healthy with no illness or birth complications. One was born with low birth weight, which is defined as being less than 2,500 grams (World Health Organisation, 2013), and spent three weeks in the neonatal intensive care unit while breastfeeding was successfully established and to monitor weight gain. Objective sleep values (sleep duration and number of sleep episodes) and rest/activity patterns (using actograms) for these two infants were compared with full-term peers. Sleep patterns and values were well within the range of other infants born at term in the study. For this reason all data from these two infants was retained for analysis.

Infant feeding

At 35–37 weeks' gestation all women in the study were planning to breastfeed their infants in the first six weeks postpartum. One woman in each group noted they also had plans for supplementing breastfeeding if this became necessary as they had undergone prior breast surgery. All women had discussed infant feeding with their partners, and all reported that they felt fully supported by their partners in these plans. At 12-weeks postpartum 90% of intervention group and 85% of control group were predominantly breastfeeding. Two intervention group mothers were solely formula feeding by 6-weeks postpartum.

Maternal sleep duration

Results relating to Hypothesis 1 are reported in the following section. Data are reported as mean (*M*) and standard deviation (*SD*) unless otherwise indicated, with significance level set at 0.05. The dependent and independent variables for objectively and subjectively measured sleep duration used in mixed effects models are shown in Table 34.

Table 34
Dependent and independent variables related to the mixed effects model analyses of maternal sleep duration

Dependent variables	Independent variables
Objective (actigraphy)	
TST_{obj} 24-hours[a]	Time, Group, Location
	Time × Group
	Group × Location
Nocturnal TST	Time, Group, Location
	Time × Group
	Group × Location
Longest nocturnal sleep period	Time, Group, Location
	Time × Group
	Group × Location
Subjective (self-report)	
TST_{subj} 24-hours[b]	Time, Group
	Time × Group

Note. [a] *TST_{obj} 24-hours is average total sleep time in 24-hours.* [b] *TST_{subj} 24-hours is usual total sleep time in 24-hours.*

Objective sleep

A total of 274 and 213 episodes of rest/sleep actigraphy were evaluated at 6-weeks and 12-weeks postpartum respectively. There were no missing actigraphy values for variables of interest at either time point. One actigraph malfunctioned on the first day of use (the event marker would not depress). The mother contacted the researcher immediately, a new *AW64* was set-up and supplied and the study recommenced 24-hours later. A second watch collected data but was affected by an error which caused a time-shift to occur in the recording. Correspondence with the *AW64* manufacturer suggested the cause was probably related to battery life or a battery fault (J. Covert, Philips Respironics/ MiniMitter, 4 November 2011). Actual durations and counts of events were still able to be used, and the sleep diary became the primary source of time information.

Twenty percent of mother and infant actigraphy files were double-scored by an independent, experienced assessor. A percentage agreement rate was calculated by counting the number of rest interval start and end times with disagreement of greater than 15 minutes and dividing this number by the total number of rest intervals scored for

all participants. Agreement rates at 6-weeks postpartum were 85% for infant scoring and 80% for maternal scoring. Agreement rates at 12-weeks postpartum were 89% for infant scoring and 90% for maternal scoring.

Table 35 provides details of sleep duration measured as total sleep time in 24-hours (TST_{obj} 24-hours), nocturnal TST (9 p.m. to 9 a.m.) and longest nocturnal sleep period. Results of mixed effects models to determine if objectively measured maternal sleep duration differed by time, group and/or location are presented in Table 36.

Table 35
Maternal sleep duration as measured by actigraphy

	6-weeks postpartum				12-weeks postpartum			
	Intervention		Control		Intervention		Control	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)
TST_{obj} 24-hours (mins)	392.6	(55.9)	412.9	(55.6)	419.8	(58.1)	412.9	(42.8)
Nocturnal TST (mins)	368.9	(54.0)	388.1	(56.9)	415.7	(58.2)	402.1	(36.8)
Longest nocturnal sleep period (mins)	214.4	(61.4)	198.8	(44.9)	270.3	(107.8)	250.7	(64.9)

Table 36
Details and results of mixed model ANCOVAs for objectively measured maternal sleep

Dependent variable	Fixed and interaction effects in final mixed model	Number of outliers removed in final model	*F*	*df*	*p*
TST_{obj} 24-hours	Time		1.62	1, 39	.212
	Group		0.44	1, 35	.511
	Location		0.11	1, 74	.746
	Time × group		2.73	1, 36	.108
	Group × location		2.28	1, 74	.136
Nocturnal TST	Time	1	10.75	1, 39	**.002**
	Group		0.14	1, 38	.711
	Location		0.30	1, 71	.589
	Time × group		6.75	1, 38	**.013**
Longest nocturnal sleep period	Time	1	13.18	1, 39	**< .001**
	Group		0.31	1, 39	.582
	Location		0.15	1, 75	.700

Note. *Boldface is significant at* p = *.05.*

Maternal total sleep duration in 24-hours

Total sleep duration in 24-hours did not change across the postpartum period. As shown in Table 36, no significant main or interaction effects for TST_{obj} 24-hours were observed in the mixed models.

Maternal nocturnal sleep duration

Results indicate a main effect of time so that, on average, nocturnal TST increased from 6-weeks postpartum to 12-weeks postpartum for all women (see Table 36). There was also a significant interaction effect of time and group for nocturnal TST (see Table 36), as is shown graphically in Figure 24. Adjusted post-hoc tests showed that there was no change in the least squares means (LSM) for nocturnal TST between 6-weeks (395 minutes) and 12-weeks postpartum (401 minutes) for the control group, $t(40.26) = -0.50$, $p = .709$. For the intervention group, nocturnal sleep increased by 46 minutes from 6-weeks (370 minutes) to 12-weeks postpartum (416 minutes), $t(36.55) = -4.30$, $p < .001$). The between groups difference in nocturnal TST was not significant at 6-weeks postpartum, $t(58.5) = 1.59$, $p = .47$, or 12-weeks postpartum, $t(58.59) = -0.93$, $p = .71$.

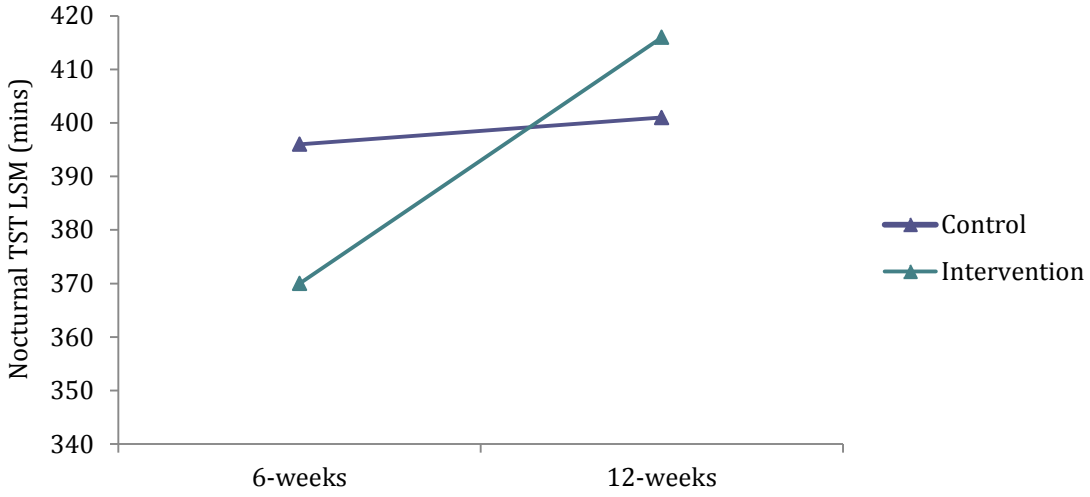

Figure 24. Interaction of time and group for maternal nocturnal sleep duration.

Longest nocturnal sleep period

There was a significant main effect of time with the longest nocturnal sleep increasing from 6-weeks to 12-weeks postpartum (see Table 36). On average, there was an increase of 48 minutes (LSM), from 206 minutes at 6-weeks postpartum to 254 minutes at 12-weeks postpartum, for all women.

Difference in nocturnal TST

Not every woman experienced an increase in nocturnal TST from 6-weeks to 12-weeks postpartum. Among intervention group mothers, 65% experienced an increase in longest nocturnal sleep period of greater than, or equal to, 30 minutes and in control group mothers 45% experienced the same level of increase. A decrease in nocturnal TST of greater than, or equal to, 30 minutes was experienced by 5% of intervention group and 30% of control group mothers. Figure 25 shows the change in longest nocturnal sleep period between 6-weeks and 12-weeks postpartum for each woman in the study.

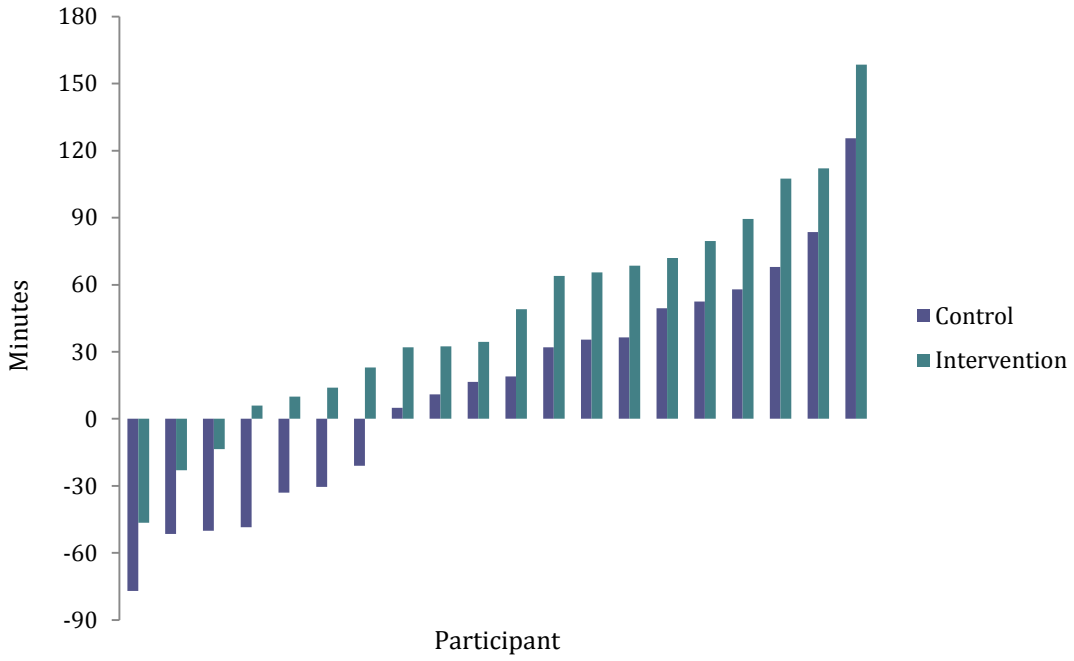

Figure 25. Change in minutes of nocturnal total sleep time between 6-weeks and 12-weeks postpartum for each woman, by group.

Daytime napping

Daytime napping was more common at 6-weeks than 12-weeks postpartum, and at 6-weeks postpartum intervention group mothers napped for significantly longer periods. At 6-weeks postpartum, seven intervention group mothers napped for an average of 64 minutes (SD = 33.16), and nine control group mothers napped for an average of 28 minutes (SD = 16.24), $t(8) = -2.46$, $p = .039$. By 12-weeks postpartum most mothers were not napping during the day. Only one intervention group mother napped (22 minutes), and three control group mothers napped for an average of 68 minutes (SD = 39.62) during the day.

Subjective sleep

Sleep duration was also measured by asking women to report the amount of sleep they usually got in 24 hours (including naps) prior to this pregnancy, at 35–37 weeks gestation, and at 12-weeks postpartum. All 40 women supplied this data (see Table 37). During the course of telephone follow-up calls, women were asked to report their total sleep duration (including naps) and the number of times they had been to sleep (sleep episodes) in the preceding 24 hours. This data is also reported in Table 37. The telephone calls made to control group mothers were brief and used a structured survey to collect sleep data for all 20 participants. Intervention group mothers took part in a longer, less structured, support and problem solving telephone call. The purpose of these calls was to focus on any questions or problems raised by the mother, and to offer support and redirection back to the resources supplied. This meant that, at the time, actual sleep duration was not always discussed. Therefore, sleep duration data is missing for four intervention group mothers at 2-weeks postpartum and three intervention group mothers at 4-weeks postpartum. The decision to include 2-week and 4-week postpartum data in statistical analyses was made *a posteriori*.

Table 37 provides details of sleep duration measured as total sleep time in 24-hours (TST_{subj} 24-hours), and number of sleep episodes.

Table 37
Maternal self-reported sleep duration and number of episodes

	Intervention	Control
TST_{sub} 24-hours (mins)[a]		
Prior to pregnancy	475.5 (56.1)	493.5 (56.3)
35–37 weeks gestation	442.5 (136.9)	454.5 (60.9)
2-weeks postpartum	391.9 (69.5)	450.8 (98.5)
4-weeks postpartum	406.8 (88.2)	445.5 (97.9)
12-weeks postpartum	427.5 (44.5)	460.5 (77.4)
Number of sleep episodes[b]		
2-weeks postpartum	2.5 (2-4)[c]	4.0 (1-5)
4-weeks postpartum	3.0 (1-4)[d]	3.0 (2-5)

Note. *TST_{subj} 24-hours is the number of hours sleep (including naps) women reported getting in the previous 24-hours (converted to minutes).* [a] *Presented as mean (standard deviation),* [b] *presented as median (range). n=20 in all groups except* [c] *n=16, and* [d] *n=17.*

Maternal sleep duration - self-report

Raw TST_{subj} values, as shown in Table 37, indicate that sleep declined across the perinatal period for both the intervention and the control group. On average, TST_{subj} was lowest at 2-weeks postpartum for intervention group mothers and at 4-weeks postpartum for control group mothers. TST_{subj} did not return to the pre-pregnancy baseline for either group by 12-weeks postpartum.

Results of mixed model analyses indicate significant main effects of time, $F(4,149) = 6.29$, $p < .001$, and group $F(1,39) = 5.12$, $p = .029$, but there was no significant time by group interaction, $F(4,29) = 0.26$, $p = .901$. Values reported here are LSM. Overall, control group TST_{subj} was 463 minutes, a difference of 37 minutes higher compared to intervention group TST_{subj} at 426 minutes, $t(38.6) = 2.26$, $p = .029$.

Figure 26 shows the main effect of time on average TST_{subj} which was highest for all women prior to pregnancy at 485 minutes. TST_{subj} was significantly less at all subsequent time-points when compared to pre-pregnancy levels, with the greatest difference being at 2-weeks postpartum (-61 minutes), $t(149) = 4.50$, $p < .001$, followed by 4-weeks postpartum (-52 minutes), $t(149) = 3.84$, $p < .001$), and 35–37 weeks gestation (-48 minutes), $t(148) = 3.63$, $p < .001$. At 12-weeks postpartum TST_{subj} had still not returned to the pre-pregnancy baseline level and was, on average, 444 minutes (-41 minutes), $t(148) = 3.10$, $p = .002$.

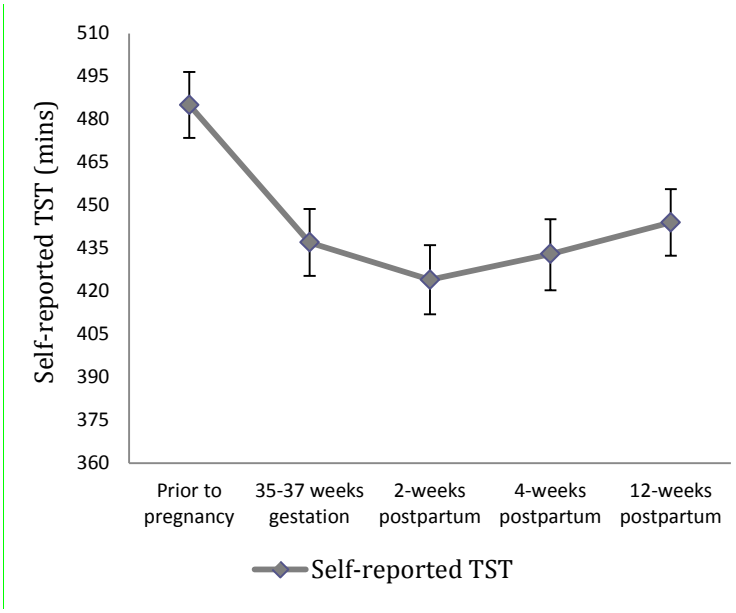

Figure 26. Main effect of time on self-reported total sleep duration for all women (LSM, with standard error bars).

Objective versus subjective sleep duration

When visually screening data, it was noted that control group mothers appeared to self-report much higher sleep duration compared to actigraphically measured sleep duration. This observation was supported when these differences were statistically tested using *t-tests.* At 12-weeks postpartum control group mean self-reported TST was 461 minutes compared to 413 minutes as measured by actigraphy, a difference of +48 minutes, $t(19) = -2.29$, $p = .03$. There was no difference between self-reported and actigraphically measured sleep duration for intervention group mothers, whose mean self-reported TST in 24-hours was 428 minutes compared to 420 minutes using actigraphy, a difference of +8 min, $t(19) = -.588$, $p = .56$. It was not possible to make comparisons at 6-weeks postpartum as self-report sleep duration was not collected at that time.

Figure 27 shows the magnitude of the difference between self-reported and objectively measured TST as a percentage for each woman, at 12-weeks postpartum. In absolute terms 50% of control group mothers over-estimated TST by more than 30 minutes and 30% of intervention group mothers made the same level of over-estimation (35% and 15% respectively overestimated by more than 60 minutes). Further analysis showed that the extent of over-estimation was not significantly different between these two groups, $t(36) = 1.73$, $p = 0.09$.

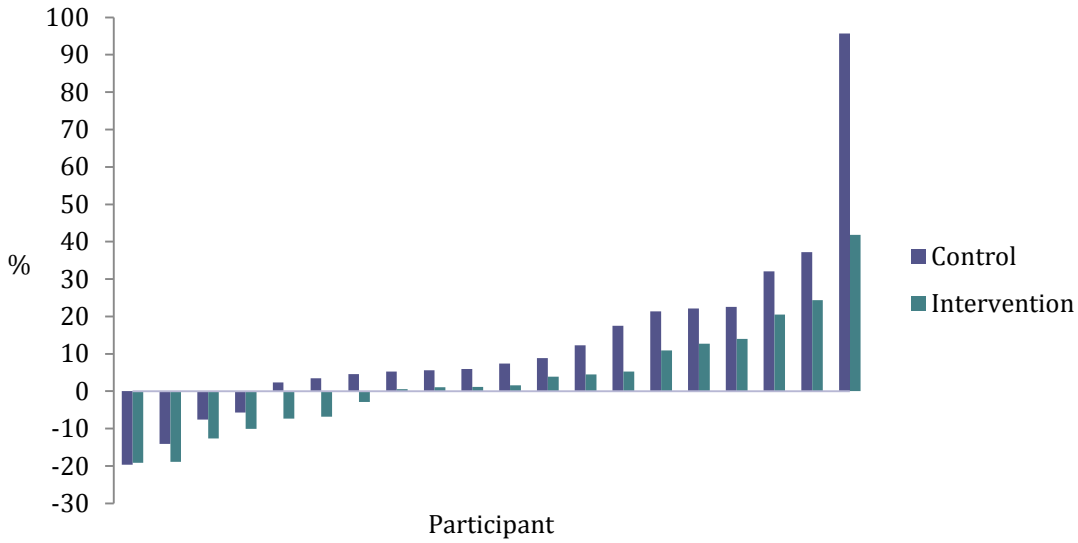

Figure 27. Percentage of over- or under-reporting of subjective to objective TST by participant. Participants ordered from greatest under-reporting to greatest over-reporting in each group.

Maternal sleep quality

Results relating to Hypothesis 2 are reported in this section. Most variables followed a normal distribution and are presented as the mean and standard deviation. As was expected, data for the number of sleep episodes did not follow a normal distribution and are presented as the median and range. The dependent and independent variables for objectively and subjectively measured sleep quality used in mixed effects models are shown in Table 38.

Table 38
Dependent and independent variables related to the mixed effects model analyses of maternal sleep quality

Dependent variables	Independent variables
Objective (actigraphy)	
Sleep efficiency 24-hours	Time[a], Group, Location Time[a] × Group Group × Location
Nocturnal sleep efficiency	Time[a], Group, Location Time[a] × Group Group × Location
Subjective (self-report)	
Good night's sleep	Time[c], Group Time[c] × Group
Sleep as a problem	Time[a], Group, Location Time[a] × Group Group × Location
Total GSDS GSDS Quality GSDS Sleepiness	Time[c], Group Time[c] × Group
Total GSDS GSDS Quality GSDS Sleepiness	Time[a], Group, Location Time[a] × Group Group × Location

Note. *Group = sleep intervention (intervention group mothers) or control (control group mothers), and Location = location of infant for sleep at night—in parental bedroom or out of parental bedroom.* [a]*Time = 6-weeks and 12-weeks postpartum.* [b]*Time = prior to this pregnancy, 35–37 weeks gestation and 12-weeks postpartum.* [c]*Time = 35–37 weeks gestation, 6-weeks and 12-weeks postpartum.*

Sleep episodes and efficiency

Both groups experienced a decrease in the number of sleep episodes in 24 hours, and the number of sleep episodes at night, between 6-weeks and 12-weeks postpartum (see Table 39). Sleep efficiency within the groups was relatively stable across the two time-periods, as shown in Table 39.

Table 39
Maternal sleep efficiency and sleep episodes as measured by actigraphy

	6-weeks postpartum		12-weeks postpartum	
	Intervention	Control	Intervention	Control
Number of sleep episodes in 24-hours	3.3 (1.0–7.3)	3.5 (2.0–6.0)	2.6 (1.0–5.0)	2.7 (1.0–6.0)
Number of nocturnal sleep episodes	3.0 (2.0–4.0)	3.0 (2.0–4.5)	2.5 (1.5–4.5)	2.4 (1.0–4.0)
Sleep efficiency 24-hours (%)	83.6 (4.4)	84.4 (4.9)	82.4 (5.7)	85.5 (2.6)
Nocturnal sleep efficiency (%)	82.6 (5.5)	83.0 (7.4)	81.8 (6.1)	84.7 (2.9)

Note. Numbers of sleep episodes are shown as mean (range). Sleep efficiencies are shown as mean (SD).

Results of mixed model ANCOVA's for objectively measured sleep efficiency in 24-hours and nocturnal sleep efficiency are presented in Table 40. The mixed model produced a significant main effect of group for sleep efficiency in 24 hours. On average, 24 hour sleep efficiency in control group mothers was higher (85.3%) compared to intervention group mothers (82.9%), $t(38.3) = 2.07$, $p = .045$. No significant differences were found for nocturnal sleep efficiency.

Table 40
Details and results of mixed model ANCOVA's and logistic regression for objectively and subjectively measured maternal sleep efficiency

Dependent variable	Fixed and interaction effects in final mixed model	Number of outliers removed in final model	*F*	*df*	*p*
Sleep efficiency 24-hours[a]	Time	1	1.13	1, 40	.295
	Group		4.30	1, 38	**.045**
	Location	1	0.83	1, 73	.365
	Group × location		2.95	1, 73	.090
Nocturnal sleep efficiency[a]	Time		0.21	1, 36	.652
	Group		1.25	1, 36	.270
	Location		0.07	1, 74	.790
	Time × group		1.32	1, 36	.259
	Group × location		0.05	1, 74	.816

Note. *Boldface is significant at* p = *.05.*

Good night's sleep

On average, the number of good night's sleep obtained by both groups declined across the prenatal period and did not return to the pre-pregnancy baseline by 12-weeks postpartum (see Table 41).

Table 41
Descriptive statistics of the number of good night's sleep obtained per week, by group, at pre-pregnancy, late pregnancy and 12-weeks postpartum

	Prior to pregnancy		35–37 weeks gestation		12-weeks postpartum	
	Intervention *M (SD)*	Control *M (SD)*	Intervention *M (SD)*	Control *M (SD)*	Intervention *M (SD)*	Control *M (SD)*
Good night's sleep	5.9 (1.0)	6.1 (0.8)	2.9 (1.9)	3.5 (1.7)	3.9 (2.1)	2.9 (2.6)

Results of mixed model ANCOVA's for sleep quality as measured by number of good night's sleep per week are presented in Table 42. A main effect of time was produced by the mixed model for the number of good night's sleep per week reported by all women. On average, participants reported getting 6 good night's sleep prior to pregnancy. This amount dropped significantly to 3.15 good night's sleep at 35–37 weeks gestation, $t(78) = 7.95$, $p = <.001$. Between late pregnancy and 12-weeks postpartum there was no change in good night's sleep, $t(78) = -0.63$, $p = .532$. There was no significant interaction effect of time by group for good night's sleep, however, there was a trend for intervention group mothers to report more good night's sleep per week than control group mothers at 12-weeks postpartum as can be seen in Figure 28, $F(2,76) = 2.53$, $p = .09$.

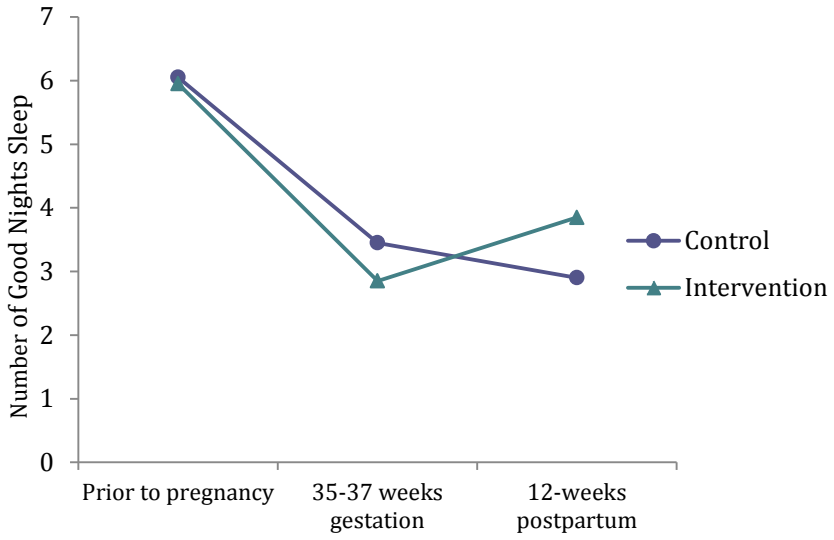

Figure 28. Interaction of time and group for good night's sleep (LSM).

Table 42
Details and results of mixed model ANCOVA's and logistic regression for good night's sleep and sleep as a problem

Dependent variable	Fixed and interaction effects in final mixed model	Number of outliers removed in final model	*F*	*df*	*p*
Good night's sleep[b]	Time	1	39.07	2, 78	**<.001**
	Group		0.04	1, 38	.837
Sleep problem[b,c]	Time		1.56	1, 35	.220
	Group		0.80	1, 38	.376
	Location		0.01	1, 12	.905
	Time × group		0.40	1, 35	.532
	Group × location		0.00	1, 12	.945
	Location × time		0.05	1, 35	.824

Note. *[a]Sleep efficiency 24-hours and nocturnal sleep efficiency were measure using actigraphy. [b]Good night's sleep and sleep as a problem were self-reported measures. [c]Sleep problem was analysed using mixed model logistic regression. Boldface is significant at* p = *.05.*

Sleep a problem

Participants were asked at 6-weeks and 12-weeks postpartum if they considered their sleep (in general) to be *no problem at all*, a *small problem* or *a very serious problem*. At 6-weeks postpartum, one woman in each group considered her sleep to be *a very serious problem*. At 12-weeks postpartum, one woman in the control group considered her sleep to be *a very serious problem*—at 6-weeks postpartum she had reported her sleep to be *a small problem*. With so few women reporting sleep to be *a very serious problem*, the decision was made to dichotomise this variable into *no sleep problem* or *any sleep problem*. At 6-weeks postpartum, 75% of intervention group and 70% of control group women reported their sleep to be a problem. At 12-weeks postpartum, 70% of intervention group and 50% of control group women reported their sleep to be a problem. A mixed model logistic regression showed no statistically significant differences between the two groups (see Table 42).

Sleep disturbance

Sleep quality was also assessed using the GSDS full scale, and sleep quality and daytime sleepiness subscales. Descriptive statistics for those scales are presented in Table 43. In general, sleep disturbance was greatest in late pregnancy and these changes can be seen in Figure 29.

Table 43
Descriptive statistics of total GSDS, and GSDS Quality and Sleepiness subscales

	35–37 week gestation		6-weeks postpartum		12-weeks postpartum	
	Intervention *M (SD)*	Control *M (SD)*	Intervention *M (SD)*	Control *M (SD)*	Intervention *M (SD)*	Control *M (SD)*
Total GSDS	3.2 (1.1)	3.1 (0.8)	3.0 (0.8)[a]	3.4 (1.4)[a]	2.5 (0.9)[a]	2.7 (1.0)
Quality	4.7 (1.9)	4.3 (1.5)	3.7 (1.2)[a]	3.8 (1.8)	3.5 (1.6)[a]	3.6 (2.3)
Sleepiness	2.6 (1.6)	2.7 (1.1)	2.2 (1.0)	2.6 (1.6)	1.7 (1.1)[a]	2.2 (1.2)

Note. [a]*n = 19*

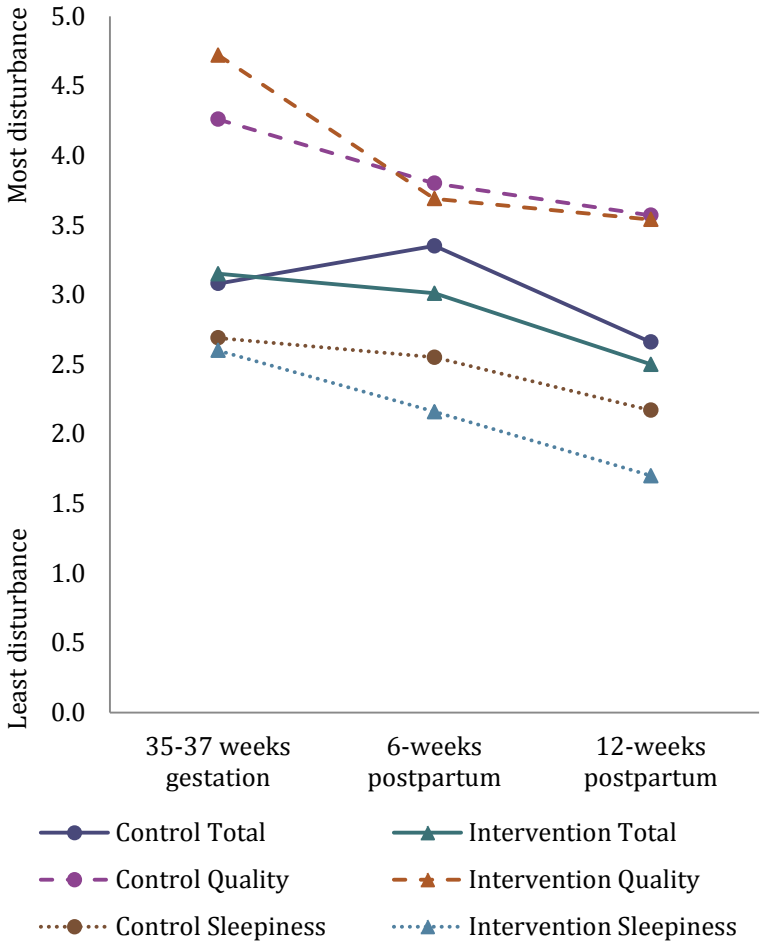

Figure 29. Changes in sleep disturbance total scale and quality and sleepiness subscales.

Table 44 shows the proportion of women for whom sleep disturbance occurred at a clinically significant level of 3 or more nights per week.

Table 44
Proportion of women reporting clinically significant sleep disturbance (GSDS)

	35–37 week gestation		6-weeks postpartum		12-weeks postpartum	
	Intervention %	Control %	Intervention %	Control %	Intervention %	Control %
Total GSDS	60	50	60 [a]	65 [a]	35 [a]	45
Quality	80	85	75 [a]	70	65 [a]	65
Sleepiness	45	45	20	30	15 [a]	20

Note. [a]*n = 19.*

Two sets of mixed effects models were run to investigate sleep disturbance in the PIPIS Study. Model 1 included data collected in late pregnancy, and at 6-weeks and 12-weeks postpartum, but did not include location of infant for sleep at night. Model 2 included postpartum data only, including location of infant for sleep at night. Higher scores represent poorer sleep and scores are presented as the least squares mean.

Model 1

A main effect of time was produced by Model 1 for all three GSDS scales (see Table 45), and these are described below. No statistically significant interaction effects were observed.

Total GSDS

On average, total GSDS was not significantly different at 35–37 weeks gestation (LSM 3.12) compared to 6-weeks postpartum (LSM 3.15) , $t(75.1) = -0.19$, $p = .853$, but it was significantly higher at 35–37 weeks gestation compared to 12-weeks postpartum (LSM 2.60), $t(74.8) = 3.43$, $p = .001$, and also higher at 6-weeks compared to12-weeks postpartum, $t(75.4) = 3.56$, $p = <.001$.

Average total GSDS in late pregnancy and at 6-weeks postpartum was at a clinically significant level (equal to, or greater than 3 nights per week). By 12-weeks postpartum, average total GSDS was no longer at a clinically significant level.

GSDS Quality

Average sleep quality was poorest in late pregnancy and remained at a clinically significant level across the duration of the study. Average GSDS sleep quality was 4.49 (LSM) at 35–37 weeks gestation and this was significantly higher than at 6-weeks (LSM 3.76), $t(74.5) = 2.01$, $p = .048$, and 12-weeks (LSM 3.53) postpartum, $t(46.4) = 2.52$, $p = .015$. Quality did not differ significantly between 6-weeks and 12-weeks postpartum, $t(46.1) = 0.77$, $p = .448$ or between groups, $t(38.4) = -0.43$, $p = .669$.

GSDS Sleepiness

Sleepiness was highest at 35–37 weeks gestation (2.66 LSM), reducing slightly by 6-weeks postpartum, at 2.37 (LSM), $t(71.1) = 1.13$, $p = .263$. Sleepiness was lowest at 12-weeks postpartum, (1.95 LSM). This was significantly lower than at 35–37 weeks postpartum, $t(41.5) = 2.52$, $p = .016$, and at 6-weeks postpartum, $t(58.4) = 2.22$, $p = .030$.

Table 45
Details and results of Model 1, mixed model ANCOVA's for the GSDS at 37-weeks gestation, 6-weeks and 12-weeks postpartum

Dependent variable	Fixed and interaction effects in final mixed model	Number of missing values (total observations)	*F*	*df*	*p*
GSDS Total	Time	3 (120)	8.14	2, 75	**<.001**
	Group		0.19	1, 37	.661
Sleepiness	Time	1 (120)	45.07	2, 75	**.001**
	Group		0.01	1, 40	.927
Sleep quality	Time	2 (120)	5.90	2, 75	**.004**
	Group		0.03	1, 44	.872

Note. *Boldface is significant at* p = *.05.*

Model 2

A main effect of time was produced by Model 2 for total GSDS and the sleepiness subscale (see Table 46). The model also produced an interaction effect of group and location for sleepiness. No statistically significant effects were observed for the quality subscale.

Total GSDS

Between 6-weeks and 12-weeks postpartum, GSDS sleep quality scores decreased (sleep quality improved) from 3.11 to 2.60 (LSM), $t(36) = 3.55$, $p = .001$.

Table 46
Details and results of Model 2, mixed model ANCOVA's for the GSDS at 6-weeks and 12-weeks postpartum, including location of infant night sleep

Dependent variable	Fixed and interaction effects in final mixed model	Number of missing values (total observations)	*F*	*df*	*p*
GSDS Total	Time	3 (80)	12.58	1, 36	**.001**
	Group		0.67	1, 37	.420
	Location		0.64	1, 62	.428
Sleepiness	Time	1 (80)	7.92	1, 38	**.008**
	Group		1.75	1, 39	.194
	Location		1.06	1, 57	.308
	Group × location		4.24	1, 57	**.040**
Sleep quality	Time	2 (80)	0.23	1, 39	.636
	Group		0.05	1, 39	.828
	Location		0.40	1, 70	.529

Note*. Boldface is significant at* p *= .05.*

GSDS Sleepiness

Between 6-weeks and 12-weeks postpartum, GSDS sleepiness values decreased significantly (less sleepy) from 2.32 to 1.92 (LSM), $t(37.8) = 2.81$, $p = .008$. An interaction of group and location showed that intervention group mothers whose baby's slept in the parental bedroom had higher sleepiness (2.21 LSM) than those whose baby's slept in their own room (1.54 LSM), $t(61.9) = -2.00$, $p = .049$. When infants slept outside the parental bedroom, intervention group mothers reported significantly lower sleepiness (1.54 LSM) than control group mothers (2.47 LSM, see *Figure 30*), $t(58.4) = 2.12$, $p = .038$. When infants slept in the parental bedroom there was no difference in sleepiness between the two groups (control group = 2.25 LSM, intervention group = 2.21 LSM), $t(52.5) = 0.08$, $p = .934$.

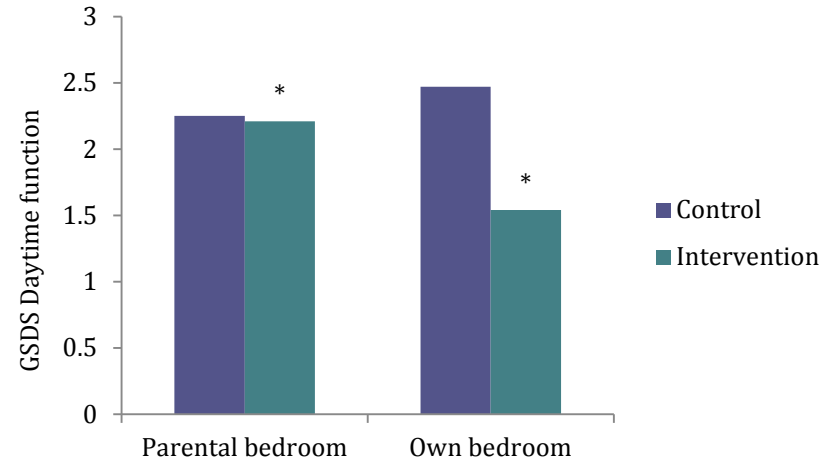

Figure 30. Overall mean scores for maternal GSDS Sleepiness subscale, by group, when infant night sleep location is in the parental bedroom versus in their own bedroom, * $p < .05$.

Infant sleep

Infant sleep location

Location of infant sleep at night was a factor in a number of maternal and infant mixed effects models in the PIPIS study. Figure 31 highlights the change in location of infant night sleeps between 6-weeks and 12-weeks postpartum. At 6-weeks postpartum, the majority of infants were sleeping in their parents' bedroom at night, $\chi^2(1) = 0.107$, $p = .74$. By 12-weeks postpartum 60% of intervention group infants remained in the parental bedroom and 65% of control group infants were in their own bedroom for night sleep $\chi^2(1) = 2.506$, $p = .11$.

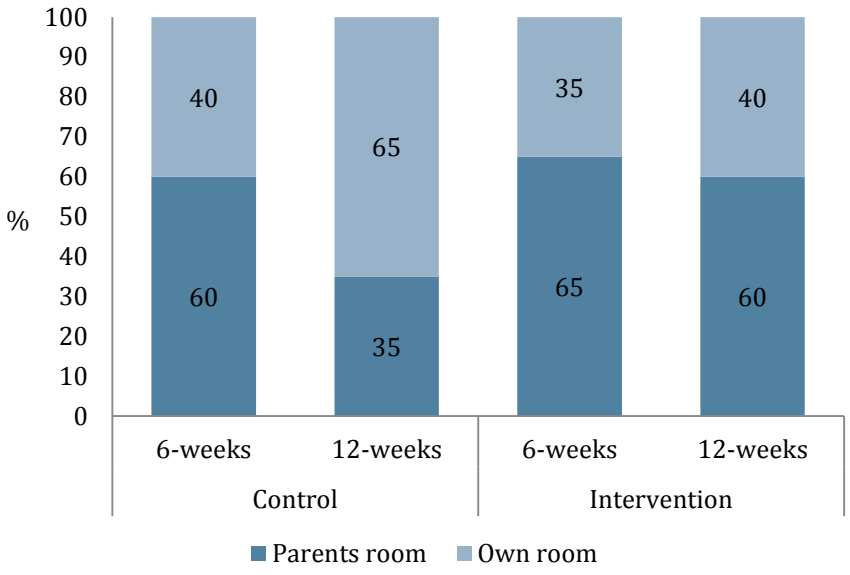

Figure 31. Proportion of infants, by group, sleeping in the parental room or their own room at night.

Holding infant during sleep and bed-sharing

Mothers were asked to record in their infant's sleep diary, places where their infant slept during the two nights of actigraphic monitoring. These responses differed to responses to the item in the PIPIS 6-week and 12-week questionnaires, asking where the infant normally sleeps at night. At 6-weeks postpartum, one woman in each group reported that her infant slept in her bed (at least part of the night), and at 12-weeks postpartum, no women reporting any bed sharing in the PIPIS questionnaires. Actual occurrence of any bed-sharing during the nights of actigraphic monitoring was therefore higher than reported 'usual' bed-sharing (see Table 47).

Table 47
Distribution of infant nocturnal sleep locations

	35–37 week gestation (planned)		6-weeks postpartum (actual)		12-weeks postpartum (actual)	
	Intervention *N (%)*	Control *N (%)*	Intervention *N (%)*	Control *N (%)*	Intervention *N (%)*	Control *N (%)*
Not decided yet	1 (5)					
Own cot/bed mother's room	13 (65)	15 (75)	13 (65)	11 (55)	12 (60)	7 (35)
Own cot/bed in own room	6 (30)	5 (25)	7 (35)	8 (40)	8 (40)	13 (65)
Own cot/bed in another room, with others						
In mother's bed						
In my bed, but in a carrier, basket /wahakura				1 (5)[a]		
Other						
Diary notes during actigraphic monitoring[b]						
Bed-sharing any part of the night	-	-	4 (20)	5 (25)	2 (10)	1 (5)
Being held for sleep any part of the night	-	-	3 (15)	11 (55)	1 (5)	2 (10)

Note. *[a]Classified for analyses as 'own bed in my room'. [b]From sleep diary notes asking where infant slept during the nights of actigraphy, display as number (percentage) of women who reported any bed-sharing or holding their infant for sleep on any night).*

One of the strategies suggested in the PIPIS programme was to look for opportunities for infants to go to sleep without proximal support (such as being fed, held, or rocked in arms). In response to the same sleep diary question above, a number of parents reported times at night when their babies were being held for sleep, and this information is also summarised in Table 47. At 6-weeks postpartum, control group infants were three times more likely to be held during part of their night sleep than intervention group infants.

Infant night time awakenings

Results related to Hypothesis 3 are presented in the following section. In the PIPIS study, infant sleep awakenings were measured objectively with actigraphy. Results of descriptive and mixed model analyses of these variables follow. Dependent and independent variables for mixed model analyses related to Hypothesis 3 are show in Table 48. Complete data was available for all 40 infants.

Table 48
Dependent and independent variables related to the mixed model analysis of number of infant night time awakenings

Dependent variables	Independent variables
Number of rest episodes	Time, group, location
	Time × Group
	Group × Location

Note*. Time = 6-weeks or 12-weeks postpartum, and Location = location of infant for sleep at night—in parental bedroom or out of parental bedroom.*

The number of rest episodes for infants at 6-weeks and 12-weeks postpartum are shown in Table 49. The frequency of infant awakenings may be calculated as the total number of rest episodes in the period of interest, minus one. By 12-weeks postpartum all infants were still having at least two episodes of rest between 9 p.m. and 9 a.m., meaning all infants were waking at least once per night.

Table 49
Descriptive statistics of number of infant rest episode variables (actigraphy)

	6-weeks postpartum		12-weeks postpartum	
	Intervention *Median (Range)*	Control *Median (Range)*	Intervention *Median (Range)*	Control *Median (Range)*
Number of rest episodes in 24-hours	7.2 (4.9–12.2)	7.3 (4.9–10)	6.8 (4–10)	6.8 (4–9.4)
Number of nocturnal rest episodes	4.0 (2–5)	3.5 (3–5)	3.0 (2–4.5)	3.0 (2–4.5)

Note. *Nocturnal period is defined as 21:00 hr to 09:00 hr. n = 20 in each group. Data for number of sleep/rest episodes did not follow a normal distribution; therefore descriptive statistics are presented as the median and range.*

A mixed model ANCOVA was used to determine whether number of infant night awakenings differed by time, group or the location of the infant for night sleep. A main effect of time was observed where the number of infant rest episodes at night decreased from 3.56 (LSM) at 6-weeks postpartum, to 3.15 (LSM) at 12-weeks postpartum, $F_{(1,40)} = 8.20$, $p = .007$. There were no differences associated with group membership, $F_{(1,38.5)} = 0.13$, $p = .719$, or location of infant for night sleep, $F_{(1,75.7)} = 0.90$, $p = .347$.

Longest maximum night time rest periods

Results related to Hypothesis 4 are presented in the following section. In the PIPIS study, infant rest duration was measured objectively with actigraphy. A series of mixed model ANCOVAs were used to determine whether infant rest duration differed by time, group or the location of the infant for night sleep. Results of descriptive and mixed model analyses of these variables follow. Dependent and independent variables for the mixed model analyses are show in Table 50. Complete data was available for all 40 infants.

Table 50
Dependent and independent variables related to the mixed model analysis of infant rest duration

Dependent variables	Independent variables
TRT_{obj} 24-hours	Time, group, location
	Time × Group
	Group × Location
Nocturnal TRT	Time, group, location
	Time × Group
	Group × Location
Longest nocturnal rest period	Time, group, location
	Time × Group
	Group × Location

Note. *Time = 6-weeks or 12-weeks postpartum, Group = sleep intervention or control, and Location = location of infant for sleep at night—in parental bedroom or out of parental bedroom. Night is 21:00 hours – 09:00 hours.*

Table 51 shows descriptive statistics for infant rest duration. Total rest in 24-hours (time in bed_{obj}), nocturnal rest duration, and longest maximum period of rest at night increased for both groups from 6-weeks to 12-weeks postpartum while longest day rest duration decreased from 6-weeks to 12-weeks postpartum.

Table 51
Descriptive statistics of infant rest duration (actigraphy)

	6-weeks postpartum		12-weeks postpartum	
	Intervention *M (SD)*	Control *M (SD)*	Intervention *M (SD)*	Control *M (SD)*
Total time in bed_{obj} in 24-hours (mins)	814.6 (111.0)	879.8 (88.0)	859.8 (119.7)	890.4 (87.1)
Nocturnal TRT (mins)	524.2 (54.1)	549.8 (47.5)	582.6 (55.5)	587.3 (47.8)
Longest nocturnal rest period (mins)	273.5 (71.8)	268.6 (57.1)	341.6 (110.7)	354.8 (97.6)
Longest day rest Period (mins)	126.1 (47.0)	137.2 (61.6)	103.2 (47.3)	119.3 (49.9)

Figure 32 summarises the changes in infant day/night rest duration from 6-weeks to 12-weeks postpartum, as well as the changes in number of day/night rest episodes. Figure 33 summarises the changes in longest infant day/night rest durations.

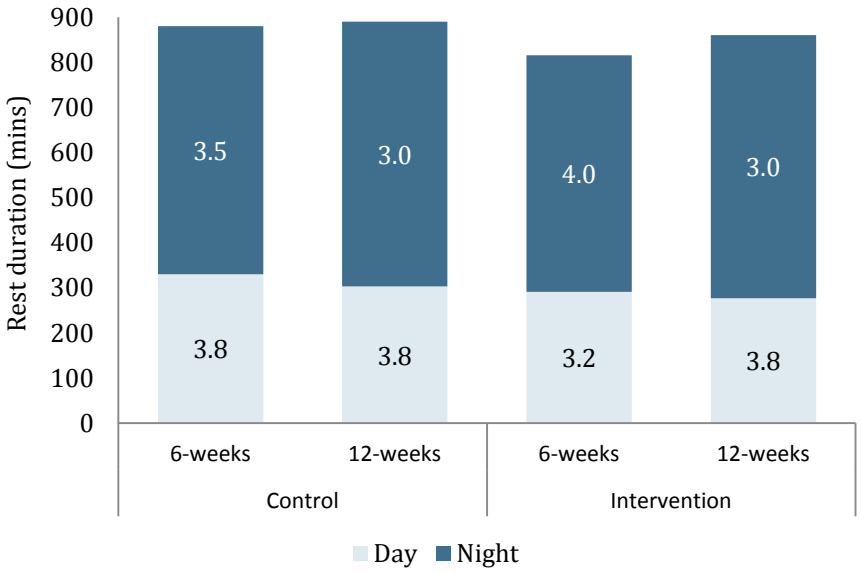

Figure 32. Change in infant rest durations by group. Each stack represents mean total rest duration in 24-hours. Darker shading shows proportion day sleep and lighter shading shows proportion of night sleep. Numbers on each block are the number of episodes in that period of the day.

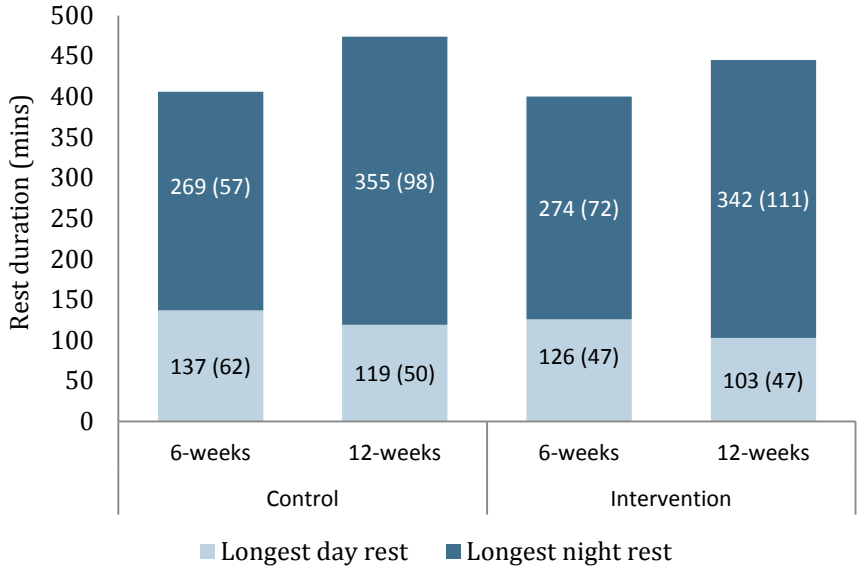

Figure 33. Change in longest infant rest durations by group. Each stack represents the total of the mean longest rest durations in 24-hours. Darker shading represents the longest period of rest during the day and lighter represents the longest period of rest at night. Numbers are minutes (standard deviation).

Table 52
Details and results of Mixed Model ANCOVA's for objectively measured infant sleep

Dependent variable	Fixed and interaction effects in final mixed model	Number of outliers removed in final model	*F*	*df*	*p*
TRT 24-hours	Time		2.20	1, 40	.146
	Group		2.89	1, 39	.097
	Location		4.04	1, 73	**.048**
Nocturnal TRT	Time		46.12	1, 39	**< .001**
	Group		0.67	1, 38	.417
	Location		0.11	1, 68	.741
	Group × location		6.16	1, 67	**.020**
Longest nocturnal rest period	Time		21.91	1, 40	**< .001**
	Group		0.02	1, 38	.876
	Location		0.03	1, 76	.853

Note. *Boldface is significant at* p = *.05.*

Infant night rest duration

Infant rest duration

The mixed effect model for infant total rest time in 24-hours produced a main effect of location (see Table 52). On average, rest was 40 minutes longer (LSM) when infants were located outside of the parental bedroom than in the parental bedroom.

Nocturnal infant rest duration

This model produced a main effect of time (see Table 52) for nocturnal rest duration so that, on average, there was an increase in nocturnal rest time from 538 minutes per night at 6-weeks to 588 minutes per night at 12-weeks postpartum, an increase of 50 minutes per night (LSM).

The interaction of group and location was also significant in this model (see Table 52). Post-hoc analyses of the interaction of group and location (presented graphically in Figure 34) showed that nocturnal TRT was significantly greater for control group infants who slept in their parents' room than intervention group infants who slept in the parental bedroom, $t(54.97) = 2.21$, $p = .031$. There was no statistically significant difference in nocturnal TST between control group and intervention group infants sleeping out of the parental bedroom $t(60.33) = -0.76$, $p = .452$.

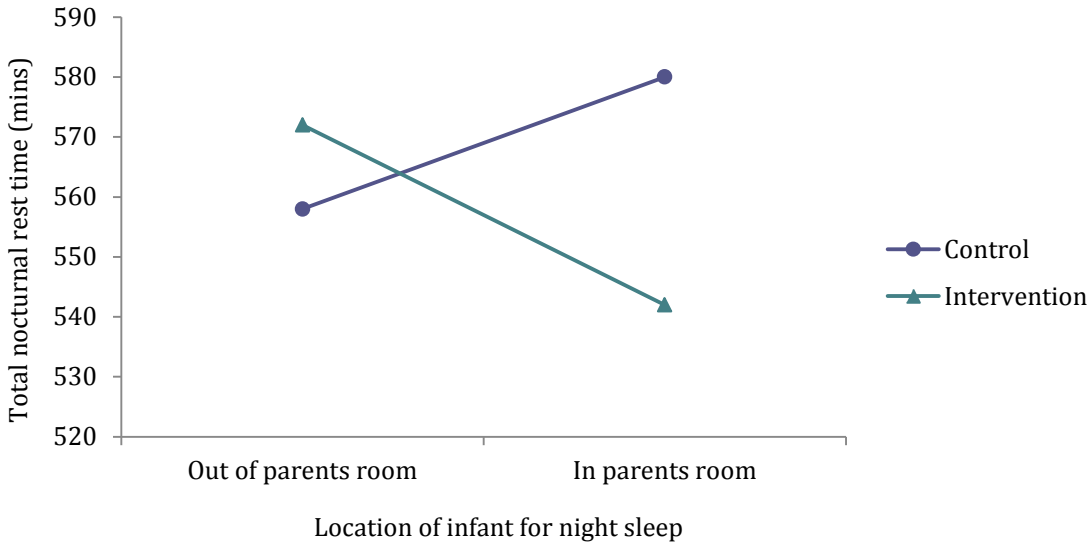

Figure 34. Interaction of group and infant night sleep location.

Longest nocturnal sleep

This model produced a main effect of time (see Table 52). On average, there was an increase in the infants' longest period of nocturnal rest from 272 minutes at 6-weeks postpartum to 348 minutes at 12-weeks postpartum (an increase of 76 minutes).

Sleep a problem

Participants were asked at 6-weeks and 12-weeks postpartum if they considered their infant's sleep (in general) to be *no problem at all*, a *small problem* or *a very serious problem*. At 6-weeks postpartum, two control group mothers and one intervention group mother considered their infant's sleep to be *a very serious problem*. At 12-weeks postpartum no mothers reported their infant's sleep to be a serious problem. As with the responses to this question for mothers, these results were dichotomised to no problem or any problem. The groups did not differ statistically when it came to reporting sleep as a problem. At 6-weeks postpartum 55% of control group mothers and 70% of intervention group mothers reported their infant's sleep to be a problem, $\chi^2(1) = .960$, $p = .327$. At 12-weeks postpartum 50% of control group mothers and 55% of intervention group mothers reported their sleep to be a problem, $\chi^2(1) = 0.100$, $p = .500$.

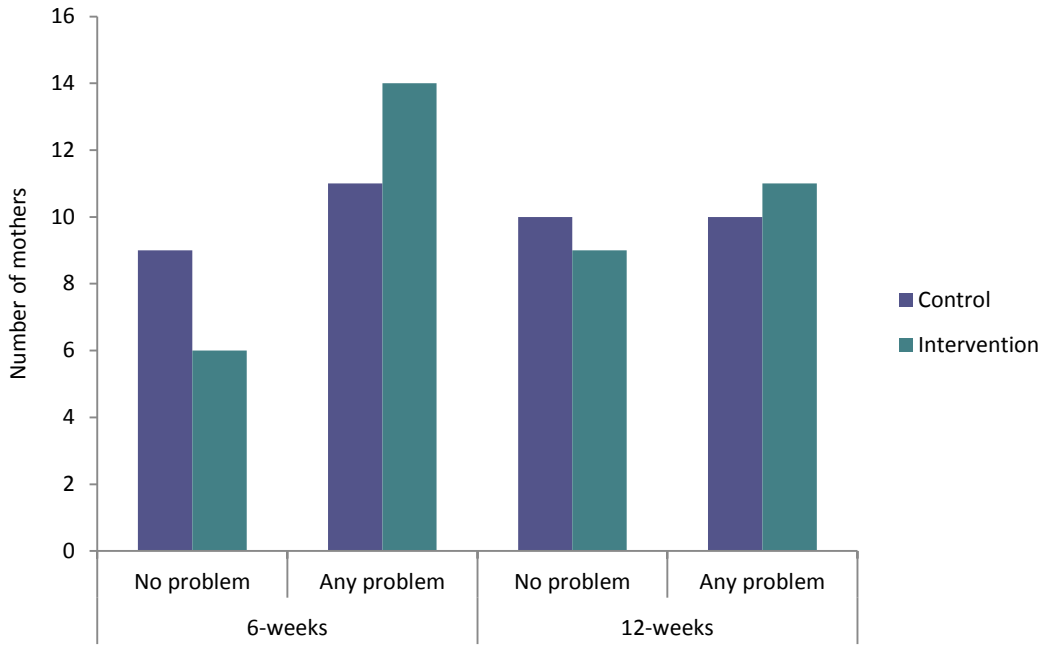

Figure 35. Number of mothers reporting their infants sleep to be no problem or any problem at 6-week and 12-weeks postpartum.

Feedback

Participants were asked to complete an evaluation form at the conclusion of their participation in the PIPIS study. Evaluations were returned by 17 intervention group (85%) and 20 control group mothers (100%).

Acceptability of the study processes

Participants were asked to rate the ease of completing the four major tasks of the PIPIS study design by choosing from *easy, OK* or *difficult* (see Table 53). Over 80% of participants found questionnaire completion and telephone contact easy. Participants found the actigraphic monitoring to be the most difficult task. Comments from participants about difficulties with actigraphy were mostly about either forgetting to press event markers, or pressing event markers being a challenge. A number of mothers felt uncertain that they had pressed the event marker correctly or firmly enough. Others commented that it was difficult to press the event marker on their infants if the infant was already asleep when placed in bed, or if they had got the infant prepared for sleep (for instance swaddled or in layers of clothing), and then remembered they needed to press the event marker. Mothers were reluctant to disturb their sleeping infant when this happened, and a number commented that this task was easier at the 12-week monitoring than the 6-week.

Intervention group mothers were more likely to select *difficult* as their answer to the question about ease of completing actigraphy.

Table 53
Participant ratings for ease of completing PIPIS study tasks

	Intervention group			Control group		
	Easy	OK	Difficult	Easy	OK	Difficult
Questionnaire completion	14	3	-	18	2	-
Actigraphic monitoring	5	5	7	7	12	1
Diary keeping	13	3	1	11	8	1
Telephone contact[a]	15	2	-	17	2	-

Note. [a]*1 control group mothers missing value.*

Seventy-one percent of intervention group mothers found the weekly support telephone calls to be *very useful*, with the remaining 29% reporting the calls to be *a bit useful*.

Intervention group women were asked if they would recommend the booklet they received at the PIPIS education session and 90% reported *definitely.* Intervention group mothers were asked if they would recommend the information they received at the antenatal education session and 95% reported *definitely*. Control group mothers were asked if they would recommend the information they received at the antenatal information only session. Fifty-five percent reported *definitely*, and 40% reported *maybe.*

Intervention group women were also asked to respond to the question *"How successful has the programme been for you in terms of helping you with your sleep and your baby's sleep?",* of the 15 women who responded, 75% responded that the programme had been *very helpful*, and a further 25% responded that it had been a *bit helpful*.

Confidence

Finally, all participants were asked to rate their own confidence on a 10-point subjective units of confidence scale, where 1 = *never confident (0%)* and 10 = *always confident (100%)*, across six infant sleep related behaviours and feelings. Intervention group mothers were more confident at being able to recognise their infant's tired cues, $t(33) = -2.247$, $p = .03$, and a trend was seen for intervention group mothers to also report higher mean confidences scores on all other items (see Table 54).

Table 54
Maternal confidence about infant sleep related feelings and behaviours

	Intervention Group		Control Group	
	M	*SD*	*M*	*SD*
Putting baby to bed awake, sleep ready	7.75	1.98	7.42	2.78
Able to recognise infant tired cues	**8.44**	1.32	6.84	2.57
Able to use a range of non-proximal strategies to get baby to sleep	7.81	2.83	7.16	2.34
Agree with partner on managing infant sleep	9.31	0.94	9.11	1.20
Finding support for infant sleep	7.56	2.90	7.00	2.49
Feel happy with infant's sleep development	8.19	1.97	7.68	2.50

Note*. Boldface is significant at* p = *.05.*

Qualitative feedback

In the comments section provided in the feedback questionnaire, control group participants indicated that they would have liked more detailed information and strategies about sleep.

> *"Own sleep dependent on babies [sic] sleep so more tips on baby's sleep useful. Tired signs. Indication of how much sleep your babies generally need." (ID7130)*

> *"More about how babies go to sleep. Why do certain practices seem to work – rocking, singing…" (ID 7509)*

> *"Would be great to have the session include more about getting your baby to sleep, what helps them sleep, etc." (ID7511)*

> *"Orient it toward practical solutions rather than optimal sleep ideas." (ID7516)*

A number of intervention group participants commented on the usefulness of the weekly telephone support calls. Examples include:

> *"Early on especially, nice to hear a friendly voice and know others were experiencing the same sleep cycles." (ID 7126)*

> *"Very helpful to talk to [the researcher] in the first 6 weeks when we were having trouble with sleep/reflux/colic." (ID 7146)*

"Loved it: was good to know that [the researcher] would call on a certain day and I could ask any questions and get advice to get through the next week." (ID7160)

"It was great to be able to ask questions and were mainly just reassuring that everything was normal." (ID7530)

Other comments about the content of the intervention included:

"It was good to know the background as to how we typically sleep." (ID7156)

"It helped me understand both mine and baby's sleep cycle and also to know that the sleep quality would improve." (ID7160).

"I wish my partner had come with me." (ID7527)

"Especially info on sleep cycles." (ID7530).

"Very informative especially about active sleep." (ID7525).

Chapter Seven

Study Two—The PIPIS Study

Discussion

Overview of findings

Sleep changes across the perinatal year are experienced by most mothers, yet little is offered to women in the way of support that positively enhances their knowledge, skills and attitudes towards this essential human function. The PIPIS Study was a trial of a behavioural-educational sleep intervention in a group of first-time mothers. The primary, overarching research question for the study was: does completion of an antenatal sleep education programme, with follow-up postnatal support, improve sleep in new mothers and their infants during the first 12-weeks postpartum?

When considering maternal sleep, the hypothesis concerning the improvement of total sleep duration in 24 hours in intervention group mothers were not supported. Over the course of the study, intervention group mothers did, however, experience a significant improvement in the amount of objectively measured sleep they obtained at night, compared to control group mothers. Results concerning maternal sleep quality and sleep as a problem were less consistent and did not support the hypothesis that intervention group women would report higher sleep quality and fewer sleep problems than control group women.

When considering infant sleep, hypotheses concerning the number of nightly awakenings by intervention group infants and the length of their longest sleep period at night were not supported in this study. Although no differences were observed between the intervention and control group infants, this study adds to the very small body of data on objectively measured sleep duration and quality for very young, New Zealand infants. Important methodological challenges in objectively measuring sleep during early infancy were identified in this study, and these are discussed.

The secondary questions for the present study related to how acceptable women found the tasks and processes of this behavioural-educational pilot trial, and, how acceptable and useful this group of first-time mothers found the PIPIS programme in

relation to their own, and their infants' sleep, in the first 3 months postpartum. Feedback from mothers relating to participation in the study, the acceptability of this type of intervention and their personal levels of confidence to understand and manage their infants sleep after participation in the intervention were favourable. This suggests the intervention has benefits beyond improving nocturnal sleep duration.

The basic methodological approach used in designing the PIPIS study was that of a pilot study. Therefore, the sample was a small, homogenous group of women from culturally similar and socially stable and well-resourced backgrounds, which allowed greater control of these variables. Pilot studies normally limit analyses to a descriptive level with equal focus on the testing of study processes, equipment and the experience of participation. Given the amount of resources involved in completing this study (including participant effort), it was decided *a priori* to capitalise on this opportunity to carry out analyses of a more complex nature. Caution must therefore be exercised in generalising any of the significant findings of this study, and likewise, a future higher powered study may produce statistically significant findings not seen, or seen only as trends in this study.

Participant characteristics

Forty first-time mothers completed the PIPIS Study, with equal numbers in a sleep intervention and a control group. The two groups did not differ significantly in terms of age, ethnicity, work and socioeconomic status. The average age of women in the study was 33 years, which is slightly higher than the average for first-time mothers in general in New Zealand (30.5 years, Statistics New Zealand, n.d.-a).

The two groups of women shared similar birth and infant feeding experiences. More than half of women in the study received medical intervention to birth their infants, either through caesarean section (25%) or instrumental delivery (27.5%). The caesarean section rate in this study parallels the national rate and that seen in Study One. The rate for induction of labour (45%) was more than double the national rate (20%) and the rate of assisted (instrumental) delivery was three times the national rate (9%). On average, the infants were born at full-term, with the average gestational age being 39.5 weeks—a finding influenced by the timing of commencing participation in the study during late pregnancy. By 12-weeks postpartum the majority of infants were still at least partially breastfed (90% intervention group and 85% control group), which is higher than the national average of 73% at this time (Royal New Zealand Plunket Society, 2010).

Maternal sleep duration

Sleep duration in 24-hours

The first hypothesis for the PIPIS Study was that mothers who completed the PIPIS Programme would obtain more sleep in a 24-hour period, at 6-weeks and 12-weeks postpartum, compared to mothers in a control group.

Sleep duration was measured objectively in the postpartum period, using actigraphy, and subjectively from prior to pregnancy to 12 weeks postpartum in the form of self-reports from participants. Changes in sleep quantity were reported by all women in the PIPIS Study, although not all in the same direction. On average, sleep duration in 24-hours declined across pregnancy with the lowest levels of self-reported sleep duration evident in the first 4-weeks postpartum. Self-reported sleep duration did not return to pre-pregnant levels for either group by 12-weeks postpartum, and women in the control group were more likely to over-report sleep duration compared to objectively measured TST. Using PSG to monitor the sleep of 45 women from prior to conception to 3 months postpartum, Lee et al. (2000) reported a similar pattern of change in perinatal sleep duration. In that study, sleep duration was highest prior to conception, it fell across pregnancy and was lowest at one month postpartum. As in the PIPIS Study, sleep duration had not returned to pre-conception baseline levels by 3 months postpartum.

These patterns of changes in sleep are not consistent with the patterns observed in Study One, although they are consistent with patterns observed by Signal et al. (2007) in a study of New Zealand perinatal women. The reason for this difference is unclear. One suggestion is that both the PIPIS Study and Signal's study were conducted with small homogenous groups of New Zealand European women, whose sleep patterns may not be representative of the wider perinatal population.

The discrepancy between objectively and subjectively measured TST in the control group was an unexpected finding and there are several possible explanations for this difference. Intervention group women were exposed to more information about sleep, sleep management and the consequences of alterations to usual sleep. This may have had the effect of sensitising them to more accurate perceptions of TST in a context of greater awareness of realistic or expected sleep norms at this time. Conversely, control group mothers, with less exposure to sleep information, may have been influenced by cultural expectations about their sleep and an anticipated return to perceived normal functioning within a relatively short period of time after childbirth. New mothers are often unprepared for the impact of postpartum sleep changes (Kennedy et al., 2007) and previous research has shown that postpartum women may be reluctant to report the

difficulties they are facing (Brown & Lumley, 1998). The extent of difference in reporting between objectively and subjectively measured sleep duration at this time is worthy of further investigation to ascertain if the basis of this bias is healthy optimism, low self-confidence or subtle pressure to conform and appear as the 'good mother'.

Mixed model analyses showed no effect from the PIPIS programme on objectively measured total sleep duration in 24-hours. At 6-weeks postpartum, there was no significant difference between the two groups. Intervention group mothers obtained, on average, 6.5 hours (393 minutes), while control group mothers obtained, on average, 7 hours (420 minutes) sleep in 24-hours. Mixed model analyses also showed that, overall, the total amount of sleep obtained in 24-hours did not increase significantly for women in this study from 6-weeks (6.7 hours) to 12-weeks postpartum (6.9 hours).

Self-reported total sleep duration in 24-hours was highest prior to pregnancy, with no significant difference between the two groups. At that time, women obtained an average of 8 hours sleep in 24-hours (485 minutes). The lowest reported 24-hour sleep duration was at 2-weeks postpartum, when average sleep was 7 hours (424 minutes). As in Study One, and in line with findings from previous studies, self-reported sleep duration did not return to the pre-pregnancy baseline by 12-weeks postpartum, when the average was just under 7.5 hours (444 minutes).

The practicalities involved in objectively measuring sleep prior to conception, in women who might or might not become pregnant in the near future, mean that the baseline measure of total sleep duration used in this study was a retrospective self-report. Using this baseline, at 4 weeks postpartum women in the PIPIS study obtained almost 52 minutes less sleep per night than they did prior to pregnancy, and at 12 weeks postpartum, average sleep duration in 24-hours was 44 minutes less than non-pregnant sleep. Given that sleep loss is considered to accumulate as a form of debt, these amounts accrue to 6 hours per week at 4 weeks postpartum and 5 hours per week at 12 weeks postpartum. The implications of cumulative sleep loss for new mothers have been discussed in Study One.

In retrospect it is considered likely that the time frame of this study was too short to observe differences between the groups should be considered. It may be that maternal sleep duration in the first three months postpartum was not amenable to change by this intervention. The needs of the infant in these early weeks largely dictate the amount of sleep mothers can obtain so that, even if motivated to do so, mothers have little control over their own sleep at this time. The most significant period for the biological development of sleep in infants is the first 3 months postpartum so extending the time frame beyond this period would give time for substantial infant sleep maturation to have

occurred. During the first three months the ability to sustain wakefulness increases, the 24-hour distribution of sleep moves from occurring evenly around the clock to predominantly occurring at night, and the percentage of REM sleep observed in day sleeps becomes less than that at night (Coons & Guilleminault, 1982; McGraw et al., 1999). It takes at least 8 weeks for sleep-wake circadian rhythms (including melatonin secretion) to appear in healthy newborns (McGraw et al., 1999).

Further evidence of sleep maturation in the first few months postpartum is associated with decreasing levels of infant movement during sleep. Reflex startles are common in newborn infants and especially so during sleep (Korner, 1969; Prechtl, 1974). During REM (active) sleep in infants, eye movements occur with gross bodily movement in infants (Aserinksy & Kleitman, 1955; Graven & Browne, 2008). These movements and startles produce arousals that can progress to full awakenings, which is one of the reasons swaddling is used across a number of cultures (Gerard, Harris, & Thach, 2002). By 4.5 months, movement time during sleep is about a quarter of what it was at 3 weeks of age, and more mature sleep stages of N2 and N3 sleep emerge by 6 months of age (Coons & Guilleminault, 1982; Mirmiran, Maas, & Ariagno, 2003). Extension of the time frame of the study, and repetition of the measures used for at least one year postpartum may allow for differences in maternal sleep between control and intervention group women to emerge.

Both subjective and objective sleep duration did not return to the self-reported, pre-pregnant baseline by 12-weeks postpartum, indicating that postpartum women are exposed to chronic sleep deprivation which started for many during pregnancy. Again, future research should aim to extend the timeframe of investigation beyond 3 months postpartum. Given that previous research suggests most infants do not sleep through the night on a regular basis until at least the second half of the first year (Anders et al., 1992; Moore & Ucko, 1957), the sleep of first-time mothers should be monitored for a minimum of 12 months postpartum to establish when, or indeed if, sleep duration returns to pre-pregnant levels. Certainly in this study a number of women were planning to return to paid employment between 3–6 months postpartum, yet, at the start of this period, sleep duration remained significantly less than it had been before pregnancy.

Nocturnal sleep duration

Although no group differences were seen in total sleep duration in 24 hours between the two groups, this was not the case for nocturnal sleep. Nocturnal sleep duration improved significantly across the postpartum period for mothers in the intervention group.

Sleep at night was analysed separately, with night being defined as the hours between 9 p.m. and 9 a.m. and in this case there was a significant effect of time, with average nocturnal sleep duration increasing by 26 minutes, from 383 minutes at 6-weeks to 409 minutes 12-weeks postpartum. *Post-hoc* analysis of a time by group interaction showed that this increase was only significant for intervention group mothers, and that nocturnal sleep in this group increased by 46 minutes over the second 6 weeks postpartum. Nocturnal sleep did not increase significantly for control group mothers.

Less than half the women in each group napped in the day during the actigraphy period at 6-weeks postpartum, but of those who did, intervention group mothers managed to nap for just over an hour on average (64 minutes) and this was significantly longer than control group mothers, who managed to nap on average for just under half-an-hour (28 minutes). By 12-weeks postpartum it appears that intervention group mothers had consolidated their sleep to the night-time, with only one intervention group mother taking a brief day-time nap, while three control group mothers continued to nap for more than an hour during the day at this time.

Sleep in humans is biologically intended to occur at night and, while most mothers appear to cope in the short term with disruption to their sleep/wake cycles, little is know about the individual differences in vulnerabilities to circadian misalignment of sleep. Napping when the baby sleeps is often recommended as a strategy for new mothers, and *any* increase in total sleep duration is likely to be more beneficial than none. Unfortunately, daytime naps can be hard to achieve because of expectations to keep up with work, household and social tasks, but equally importantly, because of biologically driven daytime wake maintenance zones. The advice to sleep when the baby sleeps can be enhanced by providing women with information about not only the benefits of napping, but also how they might choose the best time to achieve a nap, as was given to women in the intervention group of this study.

Although, there was an overall increase in the duration of sleep at night across the first 3 months postpartum, it is important to note that not all women experienced an increase. Intervention group mothers were more likely to experience an increase, with 65% experiencing an increase of 30 minutes or more, and 45% of control group mothers experiencing the same level of increase. Control group mothers were more likely to experience a decrease in their longest sleep at night, with 25% experiencing a reduction of 30 minutes or more, compared to 5% of the intervention group experiencing the same level of decrease.

During the course of the study a number of midwives reported personal observations that women who take time to rest and recover in the very early postpartum

cope better with adapting to motherhood in the long-run than those who do not. Indeed, in a number of non-Western cultures the practice of mothering-the-mother during the early postpartum is common. For instance, among Asian cultures, the practice of 'doing the month' is a time when the new mother is provided with education, support, special nourishing foods and instructed to rest. At the same time restrictions are placed on non-mothering activities and certain foods for a period of 30 days. The purpose of this confinement is to heal, recover and restore balance between body, mind and spirit in a well-supported environment (Tung, 2010). Similar traditional support systems and practices, usually lasting around six weeks, are observed in Brazil (Stefanello, Nakano, & Gomes, 2008), Japan (Yoshida, Yamashita, Ueda, & Tashiro, 2001), Ethiopia (Warren, 2010) and Zimbabwe (Mathole & Shamu, 2009).

Mothers in the PIPIS intervention group were advised to rest, nap and sleep *ad libitum.* The first 4-6 weeks postpartum were presented as a period of arrival (for the infant) and survival (for the parents), so that a focus on taking time to adapt to postnatal life, in an unpressured way was encouraged. In the absence of similar supportive systems, this advice may have implied permission for women in the PIPIS intervention group to take time for self-care in the early postpartum, including taking time for daytime naps and sleeping in later in the morning. A number of women reported during telephone support calls that they had used the PIPIS programme booklet as evidence to convince partners, family and friends that catching up on sleep in these ways was both valid and permissible.

Future studies could investigate the effects of this intervention on napping behaviour and the timing of sleep periods. This investigation should include the timing of both daytime napping and nocturnal sleep, the duration of these sleep episodes and also the longitudinal course of sleep changes into the postpartum year. Another target for future investigation is the psychological benefit to women of being actively supported and able to prioritise sleep at this time versus feeling unable to sleep whenever possible or having negative feelings, such as guilt, associated with taking time to sleep.

Longest nocturnal sleep

The objectively measured nocturnal sleep of new mothers in the PIPIS study was fragmented into an average of three distinct sleep episodes, meaning most mothers were being woken at least twice a night, usually for infant related care. The longest duration of these episodes of sleep did not differ significantly between the groups and, on average, the longest episode of sleep increased from 206 minutes at 6-weeks postpartum to 254 minutes at 12-weeks postpartum. This means that even by 3 months postpartum, the longest stretch of sleep obtained at any one time was 4.25 hours. Changes to continuity

and duration of sleep for mothers, at this stage of infant development, are seen as normative rather than pathological (Montgomery-Downs et al., 2010) but this does not mean they are without consequence. As previously described, Van Dongen et al. (2003) have demonstrated the cumulative, dose-dependent cost to neurobehavioural performance when the opportunity for sleep is restricted to 6 hours or less. The very limited data on this neurobiological 'cost' in perinatal women suggests that they are not immune to the negative effects of sleep loss (Insana et al., 2013). Further, the cumulative effects of sleep loss during the early weeks postpartum may be exacerbated by the relentless needs of the newborn infant.

Informing expectant parents of this may help create realistic expectations about postpartum sleep and allow them to plan strategies for coping with this level of disruption. This could include lowering expectations about what is achievable during the daytime, given this level of sleep disturbance; planning catch up sleep where possible, such as on partner's non-scheduled work days; and anticipating and accepting this as a normal feature of early parenting life thereby reducing tension between perceptions of ideal sleep and functioning and real sleep and functioning at this time.

This information may also allow health professionals, including midwives and Well-child nurses, to make judgements about higher than expected levels of night-waking which could indicate problems for a mother who is having difficulty maintaining sleep, for instance because of hyperarousal (Bonnet & Arand, 2010), pain (Lavigne et al., 2011) or other disturbance, or an infant who is waking more frequently than their peers because of possible feeding, general health or neurodevelopmental problems. Health professionals may then be able to offer assessment and interventions or treatment for excessive sleep disturbance beyond the normal physical and maturational needs of the infant.

Maternal sleep quality

Sleep efficiency (the ratio of actual sleep compared to time spent trying to sleep) is one measure of sleep quality and this was measured objectively using actigraphy. In non-clinical populations, of the same age as women in the PIPIS Study, normal sleep efficiency is expected to be above 90% (Boselli, Parrino, Smerieri, & Terzano, 1998; Ohayon et al., 2004; Pressman, 2002) and scores below this level may be indicative of poor or disordered sleep. Postpartum sleep efficiencies were all below 90% in this study, with nocturnal sleep efficiencies lower than those for 24-hour totals. Sleep efficiency did not change across the postnatal period studied, however, mixed effects models showed an effect of group so that, on average, control group mothers had higher sleep efficiency than intervention group mothers (85.3% compared to 82.9%). In practice, a difference of 2.4%

is negligible and not meaningful, and this effect was probably as a result of wide individual variability of sleep efficiencies. Similar sleep efficiencies have been observed in nulliparous postpartum women in a study by Signal et al. (Signal et al., 2007). PSG recordings at 6–7 weeks postpartum found that sleep efficiencies in nulliparous women ranged from 68 to 95%, with a mean efficiency of 83.6%. Multiparous women in the same study showed less variability, with sleep efficiencies ranging from 73 to 95%, and a mean efficiency of 87.5%.

Nocturnal sleep efficiency was poor for both groups with values similar to 24-hour efficiency. Despite an overall increase in sleep duration across the study, quality, as measured by sleep efficiency, showed no significant improvement. More time may be needed to see improvements in sleep efficiency and this reinforces the need to extend the duration of such a study in future.

Another measure of sleep quality used in the PIPIS Study was the number of good night's sleep obtained per week. As was seen in Study One, prior to pregnancy, women in both groups reported good night's sleep on almost every night of the week. The number of good night's sleep obtained fell significantly by 6-weeks postpartum, and did not increase by 12-weeks postpartum. There was a trend for intervention group mothers to report more good night's sleep at 12-weeks postpartum, compared to control group mothers. The number of good night's sleep reported by control group mothers continued to decline from pre-pregnancy to 12-weeks postpartum, whereas intervention group mothers reported a drop at 6-weeks postpartum followed by an increase at 12-weeks postpartum—sleep quality improvement appeared to be on an upward trajectory for this group, but was following a downward trajectory for control group mothers. This finding is consistent with the proportion of control group women who experienced decreased sleep duration between 6-weeks and 12-weeks postpartum.

Sleep was considered a problem by most women at 6-weeks postpartum, and, while mixed model analysis showed no statistically significant group differences on this measure, at 12-weeks postpartum 70% of intervention group mothers still considered their sleep a problem, compared to 50% of control group mothers—despite reporting more good night's sleep and experiencing a greater increase in nocturnal sleep duration. Again, a possible explanation for this is that intervention group mothers had been exposed to a lot more information about sleep, including the potential negative consequences of sleep disruption. These mothers may have become more sensitised to their own sleep experience, and with more knowledge about the importance of sleep, answers to this question may have been biased toward the negative, given very few women in the study were obtaining their usual sleep.

It is also interesting to note that by 12-weeks postpartum, more control group infants had been moved out of the parental bedroom. It appears that intervention group mothers were more inclined to keep their infant in the parental bedroom (perhaps following current sleep safety advice), and may therefore have been more prepared to tolerate increased disruption to their sleep through the presence of their infant in their room. Further, a bidirectional relationship may have existed with control group babies. Those babies who were considered noisy by their parents may have been relocated from the parental bedroom, thus contributing to a mother's sense that her sleep was now less of a problem, while mothers who considered their sleep to be unproblematic saw no need to make any changes, including changing the location of their infant for sleep at night. Future studies could enquire more specifically about the timing of relocation of the infants for night sleep, the reasons for doing so, and the perceived efficacy of such a strategy.

Sleep quality was also assessed using a sleep disturbance scale (the GSDS). A mean score of three or higher has been used to classify good and poor sleepers using the full GSDS scale, and significant levels of sleep disturbance on any of the subscales (Lee & Gay, 2011). Overall, general sleep disturbance fell significantly from late pregnancy to 12-weeks postpartum for all women. Although there was no significant difference between the intervention and control groups for the full sleep disturbance measure, the proportion of women rated as poor sleepers suggests a trend for greater improvement in the intervention group. In late pregnancy 60% of intervention group and 50% of control group women were classified as poor sleepers. By 12-weeks postpartum this figure had almost halved for the intervention group (35%), while the proportion of intervention group women classified as poor sleepers fell only slightly to 45%.

Sleep quality also improved from late pregnancy to 12-weeks postpartum. However, at 12-weeks postpartum two thirds of all women still met the criteria for poor sleep quality. Mean scores for sleep quality were higher in this study than previously reported for non-depressed pregnant women (Tsai & Thomas, 2012). Postnatal depression was not the outcome of interest in the current study, and few women met the criteria for major or minor depression at 3 months postpartum. As discussed in Study One, poor subjective sleep quality has been associated with the occurrence and severity of postnatal depression (Park, Meltzer-Brody, & Stickgold, 2013). The findings in Study Two reiterate the extent of sleep disturbance in perinatal women.

The impact of sleepiness on daytime functioning was most prominent in late pregnancy with 45% of all women affected at a clinically significant level. There was a significant improvement in the impact of daytime sleepiness and by 12-weeks postpartum 15% of intervention group and 20% of control group women met the clinical cut-off.

Infant sleep

The first hypothesis regarding infant sleep in the PIPIS study was that infants in the intervention group would have fewer night time awakenings than their control group counterparts. There was a significant decrease in the number of awakenings at night for all infants between 6-weeks and 12-weeks postpartum, but no difference between the groups. In this study, all infants woke at least once per night during the 48-hours of actigraphy at 12-weeks postpartum. A number of parents reported in the additional comments section of sleep diaries that on some occasions, some infants were now sleeping through the night, despite this not being the case during the actigraphy monitoring period. Anecdotally, parents often report pressure to have their infants 'sleeping through the night by an arbitrary age such as 6 weeks or 3 months.

This information should reassure parents that, although some infants may be able to sustain sleep for longer periods on a regular basis, night waking is still the norm for many infants at 3 months. The use of actigraphy also confirms what has already been reported about infant sleep, which is that parents may report that their infant is habitually sleeping through the night when in fact they are waking at least once or twice with the discrepancy being that the infants have either independently settled themselves for sleep again or not signalled strongly enough to disturb parental sleep (Sadeh & Anders, 1993).

Total infant rest duration in 24-hours did not change between 6-weeks and 12-weeks postpartum, but the amount of rest obtained by infants at night, and the length of the longest nocturnal rest period increased between the two time points. This supports an expected developmental pattern of infant sleep consolidating to the night time hours. Reports on the normative sleep patterns in infants have shown an increasing capacity for infants to sustain longer periods of nocturnal sleep across the first year (Galland, Taylor, Elder, & Herbison, 2012; Jenni & Carskadon, 2007). In the first six months the increase in longest nocturnal sleep periods is approximately 39 minutes per month, after which it reduces to approximately 10 minutes per month until 12 months of age (Galland, Taylor, et al., 2012)

The second hypothesis that infants in the sleep intervention group would have longer maximum night time rest periods at 6-weeks and 12-weeks postpartum was not supported and the groups did not differ significantly in the duration of longest nocturnal sleep period. The PIPIS programme may not have exerted a very strong 'dose' effect in that it intentionally was not directive in how parents should manage their infant's sleep, such as instructing parents to leave infants to self-settle. This may explain why the gains seen in other behavioural studies have not been seen here. Parents in the intervention group were advised to look for opportunities for their infant to settle with less and less parental input

as time went by and as they felt ready. Evidence was given of the increasing importance for this to happen as infants passed the four month age mark. In this way, the PIPIS programme could be classified as a prevention approach, suitable for infants under 6 months, as opposed to an intervention approach which might include extinction methods as a means of reducing night time signalling or crying in infants older than 6 months (Mindell et al., 2006).

A behavioural sleep programme was trialled by Sleep et al. (2002) with 610 mothers and included offering the infant a 'focal feed' (waking the infant if necessary so as to feed them infant at a prescribed time) between 10 p.m. and 12 p.m. and then trying to resettle infants who woke without feeding again between 12 p.m. and 5 a.m. Overall, there was no difference in the number of nights on which infants in both an intervention and a control group were considered to be sleeping through the night using this criterion at 12 weeks of age. By 9 months of age, however, infants in the intervention group were more likely to sleep at night without disturbing their parents, mothers reported increased confidence in their ability to cope with their infants, and the infants were more likely to have a regular bedtime routine.

Future studies should continue follow-ups of infant sleep across the first 12-months to see if differences begin to emerge in time. It is likely that very young infants are not neurologically or nutritionally ready to extend their sleep at night—those that do may have ceased signalling rather than commenced sleeping through. Pinilla et al. (1993) reported that 100% of breastfed infants were able to be 'taught' to sleep through the night, where night was defined as 12 p.m. to 5 a.m. by 8 weeks of age. No follow-up occurred after 8 weeks postpartum so it is unclear if this pattern continued. In that study, five of the thirty-three couples who enrolled subsequently withdrew from the study because of stress. St James-Roberts (2001) utilised the same method as Pinilla and found an improvement in sleeping through the night in only 10% of infants by 12 weeks of age. Parents in this study were not always willing to wake a sleeping baby for a focal feed, which was promoted as a strategy. However, parents in the intervention group of this study were less likely than control group parents to hold their baby during sleep by 12 weeks of age. At a nine month follow up, parents in the intervention group were less likely than control group parents to have sought help for crying and sleeping problems during the preceding six months suggesting that behavioural interventions which allow flexibility for parental choice can offer long-term benefits.

Given the combination of current understandings about infant sleep development, the demands of establishing feeding, recovery from labour and childbirth, and the transitions women are making to becoming a mother, it may be sensible to offer the

intervention again, after the first 3 months postpartum. This could be in the form of a booster education session to reinforce information about normative sleep development in infants. The session could also revisit the transactional model, especially in regard to behaviours which might help or hinder infant sleep development across the remainder of the first year.

Infant rest duration was influenced by where infants slept at night. Mixed model analyses showed an interaction effect of infant total rest time and infant sleep location. Total rest time was higher for control group infants who slept in the parental bedroom compared to intervention group infants. As previously discussed, this may be a reflection of control group parents keeping infants in their bedroom when infants were more settled and slept longer, but moving them out of the parental bedroom sooner if this was not the case. In contrast, intervention group parents may have been more inclined to tolerate their infants sleep patterns and keep them in the parental bedroom for longer, regardless of their night sleep duration. When infants slept outside of the parental bedroom there was no significant difference between the groups in total rest duration. Given that the current recommendations for safe sleep practice in New Zealand include advice for infants to sleep in the parental bedroom for the first six months of life (Ministry of Health, 2013a), an intervention such as the PIPIS programme may be useful in supporting and encouraging this practice.

Infant actigraphy

The PIPIS Study highlighted several difficulties in conducting actigraphy in infant populations. A number of mothers in this study found actigraphy to be a challenge, especially when it came to remembering to push event markers, or not wanting to risk disturbing an infant who had fallen asleep, but whose event marker still needed to be pushed. Mothers found this harder when their infants were 6-weeks old which is also the time when infants are more likely to drop off to sleep while feeding or being cuddled, and when they are more likely to be dressed or wrapped in multiple layers of clothing or swaddling. Sleep deprivation at this time is likely to impact maternal concentration and memory, as it has been shown to do in the sleep deprivation studies in the general population. In future studies, visual cues or reminders such as a picture card above the infant's bed, or next to the mother's bed, could be helpful in reminding women to press their or their infant's event marker but the problem of not wishing to disturb a sleeping infant may be harder to overcome. One suggestion could be to ask mothers to ensure the Actiwatch is worn on the outermost layer of infant clothing and that infants are not swaddled until just before being placed in bed—which is still likely to carry the risk of

disturbance! Mothers in this study were given the option of placing the actigraph against their infant's skin or over clothing and almost all chose the latter for reasons of practicality. This challenge reiterates the importance of sleep diary completion, which proved to be essential in corroborating actigraphy data, especially for the infants in this study.

Of greater threat to the validity of the actigraphy data collected for infants in this study was the discrepancies observed between time in bed and total sleep time as scored by *Actiware*. As previously described, normal neurological development in infants is characterised by higher levels of involuntary motility than at any other stage of life. Despite the observed high levels of activity seen in the PIPIS study, there were also times during which actigraphy detected almost no movement at all. Once again, sleep diaries were essential for determining if this was because the infant was noted as being in bed and therefore likely to be asleep, or because the infant was feeding. Gross motility may be inhibited during breastfeeding (Wolff, 1968) and in the present study many of the infants became quite still while feeding. Without the diary these periods may have been mistaken for sleep. Conversely, some mothers reported giving their infants a 'dream feed' (focal feed) late in the evening, before retiring for the night themselves. The dream feeds involved lifting the infant from sleep for breastfeeding in an attempt to delay the time that the mother would be next woken by her infant. There are currently no guidelines for scoring such feed/sleep periods. In this study, when infants were given a dream feed, the period of sleep was scored as one continuous rest episode.

Use of the *Actiware* software algorithm, at any sensitivity setting, appears to be inappropriate for investigating sleep durations in infants 3 months of age or younger. Other devices and algorithms may be more suitable.

Sleep practices

The issues of parent-infant bed sharing and SUDI are emotionally charged topics about which parents can feel conflicted. Recent media reporting of the death of a two-month old infant, who died while sleeping in his parent's bed, demonstrates this. The Coroner was reported as saying "in the Court's view, co-sleeping and the killing of innocent babies is a form of child abuse and the Court will recommend that the Government considers this aspect of child abuse in its legislative reforms" (Lynch, 2013).

Although safe sleeping practices were not the subject of this study, parents were supplied with information detailing current recommendations on this public health topic. Parents would also have received similar information at the childbirth education class they attended, and from their lead maternity carer. Despite this exposure to a consistent

message about bed sharing, a number of parents in the PIPIS study reported that they shared their bed with their infants for at least part of the night. Similar findings have been reported from a separate study. After completing an education programme promoting healthy infant sleep, including having the infant sleep in the supine position in their own sleeping place, Galland et al. (2012) reported that 15% of participants practiced bed sharing at three weeks postpartum, with this number reducing to about half by 7 weeks postpartum (Galland, Sayers, et al., 2012).

Just as there can be a mismatch between our biological needs for sleep, including duration and timing, and our 24/7 society, perhaps there is also a mismatch between the biological needs of parents and infants for close proximity and the environments in which modern Western families sleep. These environments include sleep surfaces, such as sofas and soft bedding, and parents who sometimes sleep with their infants after using alcohol and drugs, as was also the case for the previously described two-month old. Simply telling parents where to put their infant to sleep does not appear to be addressing the evidence that describes what parents actually choose to do. Comments added to sleep diaries about bed sharing in the PIPIS study indicate that parents often chose to do this in the second half of the night in order to guarantee themselves extra much needed sleep and that they enjoyed this close time with their infants.

Ball and Volpe (2013) describe a dilemma facing promoters of infant public health and safe sleep as being a choice between safeguarding (protecting infants from injury or death) and well-being (by promoting breastfeeding, attachment and mental health). Previous research has identified that parents who bed share with their babies can be classified as those who do so as a considered decision from the outset, and those who bring their infant into bed as an unplanned, reactive coping strategy. Non-routine bed sharing carries with it a higher risk of SIDS than routine bed sharing with an odds ratio of 2.18, 95% CI, 1.45-3.28 (Vennemann et al., 2012). Perhaps, then, education about infant sleep location and safe sleep should emphasise the need to understand the risk factors, regardless of whether bed sharing is planned or not, because plans can quickly change in the middle of the night.

Further, given the effects sleep deprivation has on decision making, parents would benefit from receiving this information in advance of making reactive choices about their infant's sleep. In between the options to bed share or not to bed share is the revival of traditional approaches to infant sleep including use of a safe sleep space such as a wahakura—woven flax basket (Baddock et al., 2012)—or a Pepi-Pod (plastic fabric covered box). Pepi-pods evolved as a humanitarian response to increased bed sharing following the Christchurch earthquakes in 2010 and 2011 (Mitchell & Blair, 2012) and

both forms of infant bed are currently being trialled to assess their role in the prevention of SIDS. Identifying ways for families who choose to safely co-sleep is one part of this emotive and complicated picture. Identifying ways to educate and persuade parents towards the use of safe sleep practices may well remain on the research agenda for some time to come.

Depression

The groups did not differ significantly on the level of depressive symptoms reported, and, as was found in Study One, depressive symptoms were more prominent in late pregnancy, with 32.5% of women reporting symptoms of minor depression and 5% reporting symptoms of major depression. Reporting of depressive symptoms was lowest at 6-weeks postpartum with 10% of women reporting minor symptoms and 2.5% reporting major symptoms. By 12-weeks postpartum these levels had risen again. The proportion of women who met the criteria for symptoms of minor depression was 15%, with 5% reporting symptoms of major depression. The proportions of women meeting the criteria for minor or major depression in the PIPIS Study were much lower than those seen in Study One. The relatively low levels of depressive symptomology observed in this sample may have been related to the demographic characteristics of these women. It may also have been the case that only women who were not already depressed, or were at low risk of developing depression, chose to participate in the study.

It could be expected that by 12-weeks postpartum all women would have been discharged from their obstetric care provider, yet depression symptoms were higher at this time than at 6-weeks postpartum, when routine screening would have occurred. This raises an important question about the timing of depression screening for new mothers, which has previously been discussed. Possible explanations for the lower scores at 6-weeks postpartum include that, during the first weeks, women may have received more social support from family members and partners who may have taken leave from work to help with the baby. By 12-weeks postpartum the excitement, newness and novelty of the experience may be fading, families may be receiving less special attention and pressure may be growing to be back to some form of idealised pre-birth normality. Return to work will be looming for women taking only the statutory amount of parental leave, and sleep deprivation may now be prolonged and chronic. To better understand this longitudinal trajectory of postnatal depression, future prospective studies could monitor symptoms at closer postpartum intervals and further into the postnatal year.

Feedback and confidence

Overall, participants were supportive of the study and found the tasks and processes acceptable. Intervention group mothers were more likely to select *difficult* as their answer to the question about ease of completing actigraphy. It is likely that, given the high level of engagement with the study, through weekly contact and more intensive education, these mothers felt more aware of the importance of the actigraphy, and possibly more motivation and responsibility to carry out study tasks exactly as prescribed, and this is what is reflected in these ratings. Comments sections in the questionnaire revealed no other likely reasons for the difference. All women in this study were having their first baby and these processes should also be tested in families having a second or subsequent child.

The PIPIS programme was well received by intervention group mothers. Those mothers also reported higher levels of confidence in managing their infant's sleep than control group mothers. In particular, intervention group mothers reported significantly more confidence to recognise their infant's cues for sleep readiness. Mother's found the information useful, especially in understanding infant sleep development, patterns and behaviours. They also reported that the programme gave them information that helped create realistic expectations about their sleep and their infant's sleep in the early postpartum weeks. The majority of women rated the intervention as 'very helpful' and said that they would recommend it to others. The PIPIS programme therefore has the potential to fill the gap for evidence based information on infant and maternal sleep in the first weeks after birth.

Study limitations

The limitations of self-report measures outlined in Study One also apply to Study Two. The difficulties encountered in using actigraphy in very young infants are also a limitation of this study. These meant that sleep duration was reported and analysed as total rest time rather than total sleep time. In this way, sleep duration may have been over-estimated and caution must be used when comparing values in the PIPIS Study with values in other studies of infant sleep duration.

After New Zealander/ New Zealand-European, the next biggest ethnic groups in New Zealand are Māori (14.65%), Asian (9.2%) and Pacific people who comprise 6.9% of the population at the time of the 2006[6] national census (Statistics New Zealand, n.d.-b).

[6] A national population census is conducted every five years in New Zealand. The 2011 Census was to take place on 8 March that year but was cancelled because the country was in a national state of emergency following the Christchurch earthquake on 22 February 2011. Data from the 2006 Census is therefore the most recently available.

Similar proportions were not reflected in the PIPIS sample. As for socioeconomic position, almost all women reported their annual household income to be above the national average of $67,808 (Statistics New Zealand, 2012) and few women were living in the areas of most deprivation, as measured by the NZDep06 index.

Women were recruited through a childbirth education provider offering classes in two demographically similar, but geographically separate areas of Wellington, New Zealand. Participants at these classes paid approximately NZ$210 to attend, which represents a significant proportion of the average weekly pay packet. In New Zealand, median weekly earnings from all sources are $560, and for wage and salary earners, median weekly earnings are $806 (Statistics New Zealand, 2012). In terms of social support, all women were living with a partner, and the majority reported this relationship to be a happy one, although a small number of women reported this relationship to be unhappy.

The socio-demographic features of this sample of women, including being predominantly New Zealand-European, in higher socio-economic positions, mean caution must be applied in generalising these findings to other populations. The transactional model of infant sleep/wake development suggests that infant sleep development is primarily influenced by intrinsic factors such as the infant's health, temperament, and other developmental/maturational factors, followed closely by parent-infant sleep related interactions. (Sadeh & Anders, 1993) Secondary to this, though, extrinsic factors impact the infant's parents, which in turn influences parent-infant interactions. Lee et al. (2011) conducted a randomised controlled trial of a behavioural-educational intervention aimed at promoting sleep in the postpartum. The trial evaluated the effectiveness of a sleep hygiene intervention and found that the intervention provided more benefit to mothers with fewer resources than those from socioeconomically advantaged backgrounds. Future studies should utilise multiple recruitment methods and aim to reach a larger and more representative sample of families to more accurately determine the influence these factors might have on maternal and infant sleep.

In retrospect, extending the duration of this study would have provided greater opportunity to observe differences/changes over the perinatal year and across a range of infant developmental stages.

Study strengths

Although the PIPIS study was not without limitations, it also had a number of features which gave it strength. Participant retention was high, with 93% of women who enrolled completing the study. One woman withdrew as soon as her infant was born because she felt participation would be a burden, and data from two other women were not included for analysis for medical reasons.

The use of both subjective and objective measures of sleep, including the combination of actigraphy and sleep diary, adds to the strength of this study and allowed data to be corroborated by multiple sources.

Finally, the women themselves were very supportive of the study and the information they received, no matter how limited that information was. Women in both the intervention and control groups noted that they found participation useful, and this suggests that new mothers are keen to receive information and support about sleep right from the beginning of their infant's life. No other programme in New Zealand offers sleep education, information or support for both the mother and her infant at this pivotal time.

Chapter Eight

Conclusion

Sleep occupies approximately one-third of healthy adult life and is a basic human need alongside food, water and air. At the same time, pregnancy and childbirth are common and normal events for many women, including the mothers of more than 61,000 infants born in New Zealand each year. Changes to sleep are an expected part of becoming a mother. They are so usual that women's reports of sleep change are often minimalised during the perinatal period. Evidence is mounting, at a rapid rate, that disturbed sleep is related to poorer physical and mental health in the general population. At the same time, there is limited longitudinal data about the frequency, severity or course of alterations to sleep when a woman has a baby. We do not know what is *normal* sleep or healthy sleep at this time, and even less is understood about the consequences of disturbed sleep for women during this pivotal life stage.

Sleep has been proposed as a transdiagnostic mechanism—a mechanism which is common to a range of disorders that co-occur, for instance, sleep disturbance as a mechanism shared by and maintaining insomnia, anxiety and mood disorders, or repetitive negative thinking as a transdiagnostic process in insomnia, depression and anxiety disorders, all of which are frequently comorbid. Separately and collectively sleep disorders and mood disturbance are associated with increased risk of suicide which is the leading cause of maternal perinatal mortality in New Zealand. At this extreme end of the scale the number of women affected in this profound way is few. Many more women are affected by perinatal distress which includes the experiences of worry, anxiety, depression and stress. Symptoms may be minor or severe, short-live or persistent and can rob women of the opportunity to adapt to her role and enjoy motherhood. Taking this perspective, any preventive or treatment approach which addresses perinatal sleep disturbance has the potential to offer protective value against perinatal distress and other disturbances to well-being.

Two studies were conducted in order to better understand changes to sleep at this time, the relationship of those changes to postnatal mood and to trial a supportive intervention for new mothers. The first study, a large-scale, longitudinal survey study involving a convenience sample of 951 perinatal women, successfully investigated the

relationships between perinatal sleep quality and quantity and symptoms of depression at 3 months postpartum. The second study successfully trialled a behavioural-educational sleep intervention for first-time mothers. Women were eligible to participate in only one of the two studies.

These two studies have shown that the sleep of almost every mother is affected, in some way, during the perinatal year. Moreover, women who experienced the biggest changes in the amount of sleep they obtained or the quality of that sleep also reported higher levels of postnatal depressive symptoms. Higher levels of postnatal depression symptoms were also reported by women whose sleep quality and quantity continued to decline up to 3 months postpartum.

A number of biopsychosocial factors were shown to be disturbing sleep. Physical factors included urinary frequency, pain, discomfort, and feeling too hot or cold. Cognitive and emotional factors included thinking and worrying, dreams and just not being able to sleep. Urinary frequency was the most common sleep disturbing factor in pregnancy, followed closely by factors related to comfort and pain. Meeting the essential needs of infants was the most common sleep disturbing in the postpartum period. A number of environmental factors such as the presence of pets were also noted as disturbing sleep. Not all of these factors are amenable to change, such as urinary frequency, but a number of factors may be modifiable. Sleep and mood disturbance are complex in nature and it is therefore likely that there are many potential targets for intervention, and that no single target will be the 'cure-all'. That said, even modest improvements in the sleep environment, comfort, pain, or unhelpful cognitive processes may be enough to keep the scales tipped in favour of well-being rather than distress. Modifying physical symptoms has been shown to improve sleep quality in other populations and the physical symptoms of pregnancy and the postpartum should not be left untreated.

Based on the prevalence of minor and major depression seen in Study One, more than 22,000 mothers (36%) per year will report depressive symptoms during pregnancy, and 42,000 (69%) will show indicators of anxiety significant enough to warrant further investigation. In the postpartum period, almost 10,000 mothers (16%) will experience symptoms of minor or major depression and more than 28,000 (47%) will experience heightened levels of anxiety. The effects of perinatal distress are not limited to the mother and there are implications for the infant, partners and family. Postnatal depression is the most common complication of childbirth but this does not mean it should be normalised.

The levels of anxiety observed in the E Moe, Māmā: Hauora Hinengaro study were high enough that anxiety might also be considered normal during this life stage. Even if that is the case, anxiety is commonly co-morbid with depression and anxiety may also be a

precursor to depression. It is also likely to be a stressor in its own right and this can have implications for the sleep and well-being of perinatal women. The etiology and implications of pregnancy related anxiety are yet to be fully investigated.

On average, both the quantity and quality of sleep declined from self-reported pre-pregnant levels, across pregnancy and by 3 months postpartum, neither had returned to baseline usual non-pregnant levels. Sleep duration changed in both directions so that some women experienced increases but the majority of women experienced decreases in their usual sleep duration. These findings were consistent with previous reports and add to the limited data on sleep across the perinatal period.

Novel to Study One was the investigation of the magnitude of changes to sleep and their relationship to postnatal depression. The magnitude of these changes was individually variable. Sleep duration changed by less than one hour to greater than 6 hours in some cases, and the magnitude of change was shown to be independently associated with depressive symptoms at 3 months postpartum. Women who experienced the largest percentage decreases in sleep duration also reported higher levels of depressive symptoms. The magnitude of change in sleep quality was also significantly related to higher levels of depression at 3 months postpartum. Women who experienced the largest percentage decreases in sleep quality also reported higher levels of depressive symptoms. These findings emphasise that not only is the amount of sleep obtained by women important, but equally important is the quality of that sleep.

It is acknowledged that, although these relationships were significant, the effect sizes exerted were small and causality cannot be inferred. Perinatal distress (including postnatal depression) is increasingly being understood as a complex condition, with multiple factors contributing to the onset and maintenance of symptoms. Women with a previous history of mood disturbance are at risk for perinatal distress and in the current study, experiencing depressive symptoms in pregnancy exerted the biggest effect on postnatal depression. These findings point to the need to monitor both sleep and mood across the perinatal period, and, when a women is known to be planning to conceive, this assessment could even begin prior to pregnancy. There is much emphasis on monitoring for physical disorders and disturbance in pregnancy, although sleep is not included. Mounting reports about disturbances to sleep and mood provide compelling evidence for the need to prioritise mental health and sleep health to at least the same level of screening.

Several other issues of importance emerged in these studies. Reduced help seeking behaviours in perinatal women, for both physical and mental health issues, was highlighted and needs further investigation. For instance, the proportion of women who reported being treated or monitored for incontinence raised the question of how many

women were not being monitored, but instead may be suffering in silence. Further, the relationship of perinatal incontinence to sleep has not been reported to date and warrants investigation.

Family sleep practices were highlighted as an emotionally charged and complicated issue for parents, health professionals and policy makers. The anonymous self-report measures used in these studies may have allowed mothers to be more transparent about sleep practices such as bed-sharing and holding infants during their sleep at night. This highlights the gaps between what parents are advised to do and what they are actually doing.

The PIPIS sleep education intervention showed promising results in improving nocturnal sleep in new mothers and equally importantly by fostering realistic expectations about maternal and infant sleep as well as boosting maternal confidence. This programme needs to be replicated and a number of changes are suggested. First, the study should be replicated in a larger sample size to see if the improvement in maternal nocturnal sleep remains significant. Second, the study design should include additional education sessions across the perinatal year to consolidate gains made earlier in the year, and to provide parents with information which is matched to the age and stage of their infants. Further, the materials and delivery of the programme need to be adapted to take into consideration the cultural needs of different groups of mothers, including teenage mothers, mothers who are parenting alone, adoptive mothers, mothers with disabilities or other special needs and mothers from a range of ethnic backgrounds. Adapting the materials for use with Māori families is seen as a priority.

The E Moe, Māmā: Hauora Hinengaro study is the largest study of sleep and mood in New Zealand women to date and the PIPIS Study is the first to objectively measure the sleep of mother-infant pairs in the first 3 months postpartum. It is also the first to trial a behavioural-educational sleep intervention with New Zealand mothers. The intention of these studies was in no way to pathologise the common sleep changes seen in pregnancy. Rather, the intention was to contribute to current understandings about what might constitute *normal* sleep at this time, what constitutes problematic sleep and how sleep is related to mood disturbance during this unique and dynamic life-stage.

No method exists yet for successfully predicting who will develop postnatal depression. As in a number of countries, New Zealand uses a brief measure to screen for symptoms of postnatal depression although the timing of screening will vary depending on the postnatal and well-child care a family receives. Further, routine screening does not occur in the prenatal period during which sleep and mood were found to be poorest in the E Moe Māmā: Hauora Hinengaro study. None of these screening processes routinely

include questions about sleep and the findings in the current studies suggest that adding a simple question or two about difficulty falling asleep and changes in sleep could be a valuable adjunct.

New parents often report problems with their infant's sleep and feel a tension between meeting their baby's physical and emotional needs, their own wants and needs, and the expectations of our 24/7 society. A number of non-Western cultures maintain traditional practices of 'mothering-the-mother' by creating a protected period of time for recovery from childbirth and the establishment of feeding and attachment relationships, within a supportive environment. Modern day family sleep problems may also be related to changes in how our lives are lived, particularly since the invention of the electric light-bulb. While there is no suggestion here that we should return to a pre-industrial way of life, understanding that problems which have been socially constructed (at least in part) and need socially constructed solutions is important if parents are to feel confident and supported in their role. Interventions such as the PIPIS programme offer an opportunity to align expectations with reality, and the recommendations made here about monitoring sleep and mood across the perinatal period may act as low level interventions in themselves. Then, when women are identified as having unusual or persistent changes to their normal sleep or mood, early detection, assessment, monitoring and intervention have the potential to contribute to banishing the thief that steals motherhood.

Summary of key recommendations

Future perinatal research should begin, or continue, to investigate:

- changes to sleep quality and quantity over extended periods of time, for instance, for at least the first postnatal year
- the consequences of changes to sleep in the perinatal period on maternal health and well-being
- the prevalence and consequences of short and long sleep durations
- changes in the quantity, quality and structure of sleep using objective measures
- the consequences of altered sleep (e.g. physiologic and neurobehavioural) using objective measures
- the role of social support in postnatal depression, including support to sleep and nap
- the replication and extension of CBT-I studies in the perinatal population
- validation studies of measures of perinatal sleep disturbance and distress and in particular a measure of perinatal anxiety
- validation of the EPDS for use with Māori women
- repetition and extension of the timeframe of a behavioural-educational sleep education intervention; this should also be adapted for use with women from a wider range of cultural and socioeconomic backgrounds and follow-up should occur for at least the first 12 months postpartum.

Health professionals and policy makers should consider:

- the chronicity and magnitude of changes in sleep quality and quantity in perinatal women, paying particular attention to women who experience large decreases and/or who continue to experience a decline in sleep into the postnatal period
- asking women if they have difficulty falling asleep or staying asleep (apart from to attend to their infant's needs), as these may be markers of mood disturbance
- the assessment and monitoring of factors which could disturb sleep such as pain, anaemia and unhelpful cognitions
- offering strategies and treatment to women affected by physical and psychological sleep disturbing factors
- that the subjective quality of a women's sleep appears to be at least as important as the amount of sleep she obtains in the perinatal period
- that mental health and sleep health screening should receive at least the same prioritisation as physical health screening in the perinatal year

- the timing and duration of maternity leave, including extending paid parental leave so women have the option to finish work earlier in earlier the third trimester and not return to work until at least 3 months postpartum
- that help seeking behaviour may be lower in the perinatal period than at other times in a woman's life; asking women directly about sleep, mood and physical symptoms may be required
- informing women about the relationship between extended postnatal blues and postnatal depression, and encouraging them to seek advice and assessment if the blues do not resolve after one week
- the timing of screening for postnatal depression since symptoms of depression may be masked during the 4–8 week period after birth
- using multiple methods to screen for symptoms of perinatal distress
- identify safe sleep practices which meet the needs of individual families and educating families about these so that they are an informed choice rather than a reactive decision
- providing parents and parents-to-be with evidence based information about normal infant sleep development

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Appendices

Appendix 1: Research outputs and publications

Refereed conference proceedings

Sweeney, B., Signal, L., Paine, S-J., Muller, D., Smith, AA., Priston, M., Gander, P.H., Huthwaite, M., & Lee, K. (2013). Sleep duration in the early postpartum: age and ethnicity make a difference. *SLEEP*, 36 (Abstract Supplement) A328.

Signal, L., Paine, S-J., **Sweeney, B**., Muller, D., Smith, AA., Huthwaite, M., Lee, K., & Gander, P.H.(2013). Factors influencing sleep duration and daytime sleepiness in pregnant women compared to women in the general population. *SLEEP*, 36 (Abstract Supplement) A329.

Sweeney, B, Signal TL, Babbage, D. (2012). Differences in accuracy of self-reported sleep duration between women who receive prenatal sleep education and those who do not. *Sleep and Biological Rhythms,* 10(Suppl 1), A59.

Signal, L., Paine, S-J., **Sweeney, B**., Priston, M., Muller, D., Gander, P., Lee, K., & Huthwaite, M. (2012). Sleep and sleepiness in late pregnancy: comparisons with women in the general population. *Sleep and Biological Rhythms,* 10(Suppl 1), A36.

Paine, S-J., Signal, L., **Sweeney, B**., Priston, M., Muller, D., Gander, P., Lee, K., & Huthwaite, M. (2012). Comparing sleep duration and quality prior to and during late pregnancy: results from a large sample of New Zealand women. *Sleep and Biological Rhythms,* 10(Suppl 1), A60.

Muller, D., Signal, L., Paine, S-J., **Sweeney, B**., Priston, M., Gander, P., Lee, K., & Huthwaite, M. (2012). Sleep disturbance during late pregnancy in New Zealand women. *Sleep and Biological Rhythms,* 10(Suppl 1), A69.

Sweeney BM, Signal L, & Babbage, DR. (2012). Parent Information on Parent and Infant Sleep. Trial of a sleep intervention for first time mothers in early postpartum. *SLEEP,* 35(Abstract Supplement) A417.

Sweeney B, Signal TL, Paine S-J, Lee KA, Huthwaite M, Gander PH. (2010) Enhancing recruitment and retention in a large scale, longitudinal study of sleep and maternal health. *Sleep and Biological Rhythms,* 8(Suppl 1) A72.

Sweeney B, Signal L, Jones L, & Gander P. (2009). Baby on Board: Sleep changes in pregnancy and postpartum and their relationship to self-reported drowsy driving behavior. *Sleep and Biological Rhythms*, 7(Suppl 1) P113.

Sweeney B, Signal TL, Gander P, Ellison-Loschmann L. (2008). Sleep and sleepiness in late pregnancy. *Sleep and Biological Rhythms*, 6(Suppl 1) A42.

Gander P, Signal TL, Garden A, **Sweeney B**. (2008). Comparing the views of drivers and managers/dispatchers in trucking companies entering a fatigue management system trial. *Sleep and Biological Rhythms*, 6(Suppl 1) A18.

Gander P, Garden A**,** Signal TL, **Sweeney B**. (2008). Driver fatigue levels in trucking companies entering a fatigue management system trial. *Sleep and Biological Rhythms*, 6(Suppl 1) A19.

Publications

Paine, S-J., Priston, M., Signal, T.L., **Sweeney, B.,** Muller, D. (2013). Developing new approaches for the recruitment and retention of Indigenous participants in longitudinal research: Lessons from E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand. MAI Journal, *2*(2), 121-132.

Submitted for publication, December 2013:

Signal, T.L., Paine, S-J., **Sweeney, B**., Priston, M., Muller, D., Smith, A., Lee, K.A., Huthwaite, M., Reid, P., Gander, P. Prevalence of abnormal sleep duration and excessive daytime sleepiness in pregnancy and the role of socio-demographic factors: comparing pregnant women with women in the general population.

Presentations and guest lectures

Perinatal Mental Health New Zealand Symposium, 2013: Topic: *Now I Lay Me Down to Sleep – an introduction to the unfolding story of perinatal sleep.*

Perinatal Mental Health New Zealand Symposium, 2013: Topic: *E Moe, Māmā: Sleep and Mood in New Zealand Mothers.*

University of Otago, Guest Lecturer: Postgraduate Diploma of Primary Health Care, Supporting Healthier Lifestyles – Sleep Management paper, 2012: Topic: *Pregnancy and Sleep*.

Providence Perinatal Sleep Colloquium, Brown University/Women's Medicine Collaborative, Rhode Island, 2012: Topic: *The Parent Information on Parent and Infant Sleep Project*.

Royal New Zealand Plunket Society: Education session for PlunketLine nurses, 26 October 2012, Topic: *Maternal and Infant Sleep*.

Sweeney, B.M.J., Signal, T.L., Paine, S.J., Priston, M., Muller, D.P., Gander, P.H., Huthwaite, M.A., & Lee, K.A. (August, 2012). *E Moe Mama, Maternal Sleep and Health in Aotearoa/New Zealand: Preliminary findings of a large scale perinatal sleep study.* Presentation at New Zealand College of Midwives Biennial Conference, Wellington, New Zealand.

Sleep in Aotearoa, New Zealand meeting of the Australasian Sleep Association & Australasian Sleep Technologists Association. Wellington 2011. Topic: *Parent Information on Parent and Infant Sleep.*

Signal, L & **Sweeney, B.** (October, 2009). *"Sleeping badly? It's just nature's way of getting you ready for baby".* Presentation to Wellington Postnatal Depression Seminar Day, Wellington, New Zealand.

Other forms of dissemination (popular press)

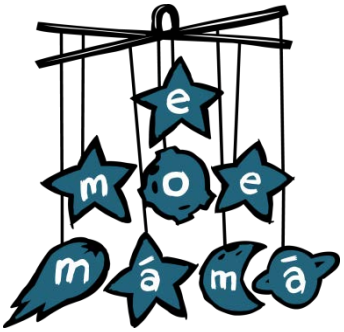
Radio/Television interviews

- Waatea News, National Radio, 10 June 2009**.**
- Good Morning TV One: Sleep and postnatal depression new study. Interviewer: Sarah Bradley, 4 November 2009.

Newspaper articles

- Sleep on the research radar. Taranaki Daily News. Reporter: Virginia Winder, 26 August 2009.
- Massey recruiting pregnant women for sleep study. Cook Strait News/Porirua News. Reporter: Agnès Ginestet, 27 January 2010.
- Spasifik Online Magazine: Sleep and new babies, 2011.

Appendix 2:
Contents of E Moe, Māmā study information pack



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Whiringā-ā-nuku, 2009

E te Rangatira, tēnā koe

E ngā waka, e ngā mana, e ngā reo,
e ngā kārangatanga maha o ngā hau e whā,
ko tēnei te mihi atu ki a koutou.
Tēnā hoki koutou i roto i ngā āhuatanga o tēnei wā.
Nō reira, tēnā koutou, tēnā koutou, tēnā koutou katoa.

E Moe, Māmā
Moe Kahurangi Me Te Hauora i Aotearoa
Maternal Sleep and Health in Aotearoa/New Zealand

He mātuatua te moe ki tā tātou hauora.
Sleep is very important for our health.

He rōpu rangahau tātai raupapa-maha Te Pokapū Rangahau Moe/Oho.

The Sleep/Wake Research Centre is a multi-disciplinary research team.

Kei te ū rātou ki te whakapiki i te hauora, te whakaritenga, te haumaru, me te oranga ā ngā iwi o Aotearoa i runga noa i te arotau o ngā here i waenga i te moe me te āheinga ohotanga.

They are committed to improving the health, performance, safety, and well-being of New Zealanders through a better understanding of links between sleep and the waking function.

Ko ngā mema ā te Pokapū Rangahau Moe/Oho rōpu kei te whai pānga ki tēnei rangahautanga, ko Dr. Leigh Signal (Āpiha Rangahau Mātāpuputu me te Kaititiro Mātāpono), Dr. Sarah-Jane Paine (Tūhoe, Taura Tohu-Kairangi Pūkenga Rangahau), Ms. Bronwyn Sweeney (Taura Tohu Kairangi), me Ahorangi Philippa Gander (Kaiwhakahaere).

The members of the research team involved in this study from the Sleep/Wake Research Centre are Dr. Leigh Signal (Senior Research Officer and Principal Investigator), Dr. Sarah-Jane Paine (Tūhoe, Post-Doctoral Research Fellow), Ms. Bronwyn Sweeney (PhD student) and Professor Philippa Gander (Director).

Kei te mahi hoki mātou me Ahorangi Kathy Lee (Ahorangi Nēhi me te Kaiwhakahaere Tuarua, kaupapa ngāoriori i te wā whakarite i mua i te whānautanga) mai te Whare Wānanga o Karipōnia, me Tākuta Mark Huthwaite (Pukenga Mātapuputu me te Mata Mate Hinengaro) mai te Whare Wānanga o Ōtako, kei Te Ūpoko-o-te-Ika.

We are also working with Professor Kathy Lee (Professor in Nursing and Co-Director, Perinatal Nursing Program) from the University of California and Dr. Mark Huthwaite (Senior Lecturer and Psychiatrist) from the University of Otago, Wellington.

He tono tēnei ki ā koe kia uru mai ki te rangahautanga e tūhura ana i te moe me te hauora kahurangi ō ngā wāhine hapu me ngā wāhine i muri i te whakawhānau.

You are invited to take part in a study investigating sleep and maternal health in pregnant and postpartum women.
E rima rau ngā tono ka tūkuna ki ngā wāhine Māori, e rima rau ki ngā wāhine tauiwi, kia urutau ki tēnei rangahautanga i te mea ka whakamahia a mātou raraunga hei titiro ki ngā rerekētanga o ngā mātāwaka.

Five hundred Māori and 500 non-Māori women will be invited to participate in this study as we will be using our data to look for differences by ethnicity.
I nāianei kei te kaha mātou ki te rapu:

We are currently trying to find out:

1. Me kore ra he pānga i waenga i te moe roa me te kounga i te haputanga tōmuri, te roa o te whakamamae, ā, me te āhuatanga o te wheako o ngā wāhine whakawhānau.

   If there is a relationship between sleep duration and quality in late pregnancy and the duration of labour and type of birth women experience.
2. Me kore ra he pānga i waenga i te moe roa me te kounga i te haputanga tōmuri i te wā i muri i te whakawhānau me ngā rerekētanga o te āhua ngākau i te wā i muri i te whakawhānau.

   If there is a relationship between sleep duration and quality during late pregnancy and early postpartum and changes in postpartum mood.
3. Kei te kaikaha mātou ki te arotau me kore ra he taurea ka awe ki ēnei whai pānga.

   We are also interested in understanding if there are other factors that might influence these relationships.

Kei tēnei tāhere akoranga he puka pārongo e whakamārama pai ana i te rangahautanga.

In this study pack you will find an information sheet that explains the study in more detail.

Me ka waitohu koe ki te urutau ki te rangahautanga ā-muri i te pānui i te puka pārongo, me whakakī koe i te puka whakaae me te pepa pātai.

If you choose to participate in the study after reading the information sheet, please complete the consent form and questionnaire.

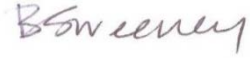
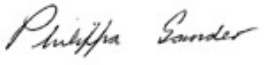
Me rau atu te puka whakaae me te pepa pātai ki te kōpaki whai-ingoa, ka whakahoki ki te rōpu rangahau.
Please use the self-addressed envelope provided, and return the consent form and questionnaire to the research team.

Ka tāea e koe te whakapā tika atu ki tētahi mema o te rōpu rangahau me he āwangawanga he pātai rānei āu mō te rangahau ki te wāhi me ngā nama wāea kei konei.

You can contact any member of the research team directly with any concerns or queries about the survey at the address and phone numbers given.

Tēnā koe me tō manawa popore ki tēnei rangahautanga.
Thank you for your consideration of this study.

Nō reira, noho ora mai ra
Nā mā



Rarau (puka whakaae, whārangi pārongo, pukapuka pātai, kōpaki whai-ingoa)
Encl (Consent form, Information sheet, Questionnaire, Post-paid return envelope)

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PUKA WHAKAAE
CONSENT FORM

E Moe, Māmā

Moe Kahurangi Me Te Hauora i Aotearoa
Maternal Sleep and Health in Aotearoa/New Zealand

Me ka waitohu koe ki te urutau ki te rangahautanga, me whakakī koe it te puka whakaae kei roto i te pūkoro ā-tata tonu nei.
If you have decided to participate in the study, please complete and return this consent form in the envelope provided as soon as possible.

Me whakahoki tāuke kia tae ana koe ki waenganui i ngā wiki 35-37 o te haputanga. Mā mātou e tuku he whakamāharahara ki a koe me tētahi atu pūkoro whakahoki.
The questionnaire can be returned separately once you are between 35 and 37 weeks pregnant. We will send you a reminder and another return envelope.

- Kua pānuitia ā kei te mārama ahau ki te puka pārongo mō te marama o Whiringā-ā-nuku 2009 mō ngā kaitūao kua uru ki te rangahautanga tūhura moe me te hauora kahurangi ō ngā wāhine hapu me ngā wāhine i muri i te whakawhānau. Kua whai wāhi ahau ki te matapaki i tēnei rangahautanga. Kei te ngata ahau ki ngā whakautu i hōmaitia ki ahau.

  I have read and I understand the information sheet dated October 2009 for volunteers taking part in the study designed to investigate sleep and maternal health in pregnant and postpartum women. I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.

- Kua whai wāhi ahau ki te totoro ki tāku whānau, me kore ra, he hoa hei tautoko i ahau ki te uiui pātai me te mātau i te rangahautanga.

  I have had the opportunity to use whānau support or a friend to help me ask questions and understand the study.

- Kei te mātau ahau he urunga tūao tēnei i te rangahautanga (kei ahau te mana whiringa), ā ka tāea e ahau te kuounu mai i te rangahautanga angi noa te take,ā, e kore tēnei e kawekawe i tōku hauora manaaki.

  I understand that taking part in this study is voluntary (my choice), and that I may withdraw from the study at any time and this will in no way affect my health care.

- Mātau ana ahau ko te urunga ki tēnei rangahautanga he tapu, ā kīhai e whakamahia ngā rauemi tuhi hei tautohu i ahau i ngā ripoata katoa mō tēnei rangahautanga.

  I understand that participation in this study is confidential and that no material that could identify me will be used in any reports on this study.

- I whai wā ahau ki te kohuki mehemea ka uru ahau ki te rangahautanga.

  I have had time to consider whether to take part in the study.

- Mōhio ana ahau me whakapā atu ki a wai mehemea he pātai āku mō te rangahautanga.

  I know whom to contact if I have any questions about the study.

- Kei te hiahia ahau ki te whiwhi tārua o ngā whakatau.

  I wish to receive a copy of the results. AE / YES KAO / NO

Kia mataara ki te tōmuritanga o te kohinga raraunga me te tānga pukapuka o ngā whakatau. Ka oti tēnei rangahautanga i roto i nga ngā tau e toru, ā ka puta ngā whakatau i waenga i te tau 2012.
Please be aware that there will be a delay between data collection and the publication of the results. This study will take 3 years to complete and the results will be available in mid 2012.

- Ka whakaae au ki te tuku i ngā pārongo e pā tahi ana ki te whānautanga o tāku pēpi ki te whare kohanga i whānau ai tāku pēpi.

I consent to information related to the birth of my baby being made available by the maternity service where I give birth. AE / YES KAO / NO

- Ki te whakataunaki ngā puka pātai ka piki ake te tāpokopokotanga mō te pouri i muri i te whānautanga, ka whakaae ahau kia tukuna tēnei pārongo ki taku kaitiaki ōmahu whaitaki, me kore ra ki taku tākuta, me kore ra ki tētahi atu pūkenga hauora.

If any of the questionnaires suggest that I am at elevated risk for postnatal depression I consent to this information being sent to my Lead Maternity Carer, doctor or other health professional.
AE / YES KAO / NO

Me kua WHAKAAE koe tuhia ngā ingoa me ngā wāhi o te kaitiaki ōmahu whaitaki / me te tākuta
If YES please provide Lead Maternity Carer/doctor's name and location
_____

Ko ahau (ingoa tohu_____
I (full name)
mai konei te whakaae ki te urutau ki tēnei rangahautanga.
hereby consent to take part in this study.

Te wā_____ Waitohu _____
Date *Signature*

MĀTUATUA: kia mōhio ai mātou a hea, ā kei hea koe hei whakapā atu mō te wā i muri i te whānautanga o te rangahautanga, me whakakī i tēnei wāhanga:

IMPORTANT: So that we know when and where to contact you for the postnatal part of the study, please complete the following:

Wāhi noho _____Te wā whānau o pēpi _____
Address *Date baby is due*

_____Wāea kainga
Phone (home)

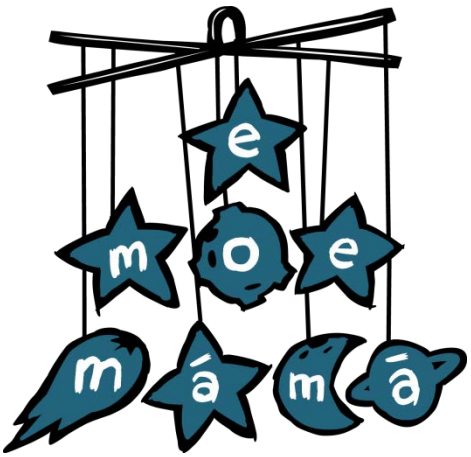
_____ Wāea pūkoro
Cellphone

_____ Tātai poutāpeta _____
Postcode

Īmēra _____
Email

Me kore noa te īmēra mahi me e kore koe e te tiki ana i aua īmēra ā-muri mai i te whānautanga o tō pēpi.
Preferably not a work email unless you will be accessing those emails after your baby is born.

Ka tūkuna ki a koe he kape whakaahua o te puka whakaae.
A photocopy of the completed consent form will be returned to you.



INFORMATION SHEET

E Moe, Māmā

Moe Kahurangi Me Te Hauora i Aotearoa

Maternal Sleep and Health in Aotearoa/New Zealand

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He tono tēnei ki ā koe kia uru mai ki te rangahautanga e tūhura ana i te moe me te hauora kahurangi ō ngā wāhine hapu me ngā wāhine i muri i te whakawhānau.
You are invited to take part in a study investigating sleep and maternal health in pregnant and postpartum women.

He tūao tō urunga (nāu te kōwhiringa). Kei i a koe te mana ki te uru ki tēnei rangahautanga, ā, ki te kore koe e uru, e koretēnei e kawekawe i tō manaaki me tō tiakitanga ināianei, me ā-muri ake nei.
Your participation is entirely voluntary (your choice). You do not have to take part in this study and if you choose not to take part this will in no way affect your current or future care or treatment.

Me ka whakaae koe ki te uru ki tēnei rangahautanga, kei a koe te mana ki te kounu mai i te rangahautanga, angi noa te take, ā, e kore tēnei e kawekawe i tō manaaki me tō tiakitanga ināianei me ā-muri ake nei.

If you do agree to take part in the study, you are free to withdraw from the study at any time, without having to give a reason, and this will in no way affect your current or future care or treatment.

Te Rangahautanga
About the study
Ngā whainga o te rangahautanga:
The aims of the study are to:

1. Ki te tūhura i te pānga i waenga i te moe roa me te kounga i te wā tuatoru o te haputanga me te roa o te whakamamaetanga i te āhuatanga whakawhānau, ā, me te whakatau tērā pea he taurea ka awe i tēnei pānga.

   To investigate the relationship between sleep duration and quality during the third trimester of pregnancy and duration of labour/type of birth, and determine factors that might influence this relationship.

2. Ki te tūhura i te pānga i waenga i te moe roa me te kounga i te haputanga tōmuri me te wā i muri i te whakawhānau me ngā rerekētanga o te āhua ngākau i te wā i muri i te whakawhānau, ā, me te whakatau tērā pea he taurea ka awe i tēnei pānga.

   To investigate the relationship between sleep duration and quality during late pregnancy and early postpartum and changes in postpartum mood, and determine factors that might influence this relationship.

Ngā Kaiwhakauru
Participants
Ka tukuna he tono ki ngā wāhine hapu tahi mano (rima rau he Māori, rima rau he tauiwi) kia uru mai ki tēnei rangahautanga ā tā rātou kaitiaki whakawhānau, me kore ra, ko tā rātou kaiwhakaako whakawhānau.

1000 pregnant women (500 Māori and 500 non-Māori) will be invited to participate in this study by their antenatal care provider or childbirth educator.

He hōkaitanga, ka tāea e ngā wāhine te whakapā tika atu ki te rōpu rangahau kia kite rātou i te pānui mō te rangahautanga, me kore ra, kia rongo kōrero rātou mai i tētahi atu mō te rangahautanga.
Alternatively, women may contact the research team directly after seeing an advertisement for the study or after hearing about the study from someone else.

Kia tekau-mā-ono tau ngā wāhine, me kore ra, he pākeke ake, ā kia mātau ki te whakaoti i te pepa pātai i roto i te reo pākeha.
Women must be 16 years of age or older and be able to complete a questionnaire in English.

Te wāhi me te wā o te rangahautanga
Location and timing of the study
Ka tāea e koe te whakautu i ngā pātai i te wā e pai ana ki a koe i tōu ake kainga. E whā marama te wā o tō urunga ki tēnei rangahautanga. E toru tau te roa o te rangahautanga katoa, ā, ka oti i waenga o te tau 2012.

All study questions can be answered by you in your own time and in your own home. Your participation in the study will be over a 4 month period. The entire study will run for 3 years and be finished in the middle of 2012.

He aha te pānga ki te urutau koe?
What is involved if you decide to participate?
Ki te whakaae koe ki te urutau ki te rangahautang, ko ēnei ngā pātai ki a koe:

If you decide to be in the study you will be asked to:

- Me whakaoti te pepa pātai ka whakahoki a ngā wiki 35-37 o tō haputanga. Ka oti te pepa pātai pātata ki te 30-40 miniti.
  Complete and return a questionnaire in weeks 35-37 of your pregnancy. The questionnaire takes approximately 30-40 minutes to complete.
- Me whakaoti he wāea uiui kia ono wiki te pakeke a tō pēpi. Ka oti pātata ki te 10 miniti.
  Complete a phone interview when your baby is about 6 weeks old. This will take about 10 minutes.
- Me whakaoti te pepa pātai whakamutunga ā ka whakahoki pātata ki te wiki 12 a-muri mai i te whānautanga. Ka oti te pepa pātai pātata ki te 30-40 miniti.
  Complete and return a final questionnaire approximately 12 weeks after birth. This questionnaire takes approximately 30-40 minutes to complete.
- Me kua heipū whakaae koe kia mātou, kā tīkina e mātou ngā pārongo i te rātonga whare kohanga i whakawhānau ai koe, ki te tiki pārongo pērā i te roa o tō whakamamae, me te āhuatanga o te whakawhānau (kiritapu tūpono noa, nga taputapu, te mea, te mea) me te taimaha o tō pēpi i te whānautanga.

  If you have given us permission, we will access information from the maternity service where you gave birth to obtain information such as the duration of your labour, type of birth (e.g. spontaneous vaginal, forceps, etc), and birth weight of your baby.

Ngā hua, tāpokopokotanga me te haumaru
Benefits, risks and safety
Me ka waitohu koe ki te whiwhi i ngā whakatau o te rangahautanga, ka whai wāhi koe ki te ako i ngā tikanga moe me ngā pānoni ki te moe i muri tonu atu, ara, i mua tonu atu i te whānautanga o tō tamaiti.

If you choose to receive the results of the study, you will have an opportunity to learn about sleep and the changes to sleep that occur immediately before and after the birth of your child.

He iti te rarua ka whai pānga ki te wā hei whakaoti i ngā pepa pātai. Heoi, ka whiwhi koe i te $20 tīkiti (penehīni, he toa kai rānei) kia whakahoki koe i te pepa pātai oti i te haputanga tōmuri, ā i ngā wiki 12 i te wā i muri i te whakawhānau. He tākoha tēnei ki a koe me ka hiahia kaitiaki koe, kia whai wā ai koe ki te whakaoti i ngā pepa pātai.

There is a minor inconvenience associated with the time required to complete the questionnaires. You will, however, be provided with a $20 voucher of your choice (petrol, supermarket or department store) when you return a completed questionnaire in late pregnancy and at 12 weeks postpartum. This is to reimburse you if you require a babysitter to provide you with enough time to complete the questionnaires.

Aha noa
General
Ka mōhio taku tākuta, me kore ra, taku kaitiaki ōmahu whaitaki kua uru ahau ki te rangahautanga?
Will my GP and/or Maternity Carer be told I am in the study?
Kei te pepa pātai me ngā wāea kōrero he tauine hei takitaki mō te pouri i muri i te whānautanga. Ka kōrero atu rātou ki a koe me ka whakataunaki ngā tauine kei te tāpokopokotia koe i tēnei tīrangaranga. Ka whakataunaki mātou me haere koe ki hea mō tētahi atu aromātai ā me te tiakitanga. Me ka waitohu koe, mā mātou tonu e whakamōhio atu ki tō kaitiaki ōmahu, ki tō takuta, me kore ra, ki tētahi atu hauora kaitiaki whaitaki.

Included in each questionnaire and the phone call is a scale to screen for postnatal depression. If the results of the scale suggest you may be at risk from this disorder then we will tell you. We will then suggest where you can go for further evaluation and treatment. If you choose, we will also notify your Lead Maternity Carer, GP or other health care provider.

Kei hea ētahi atu pārongo mō te rangahautanga?
Where can I get more information about the study?
Ka tāea e koe te whakapā atu ki tētahi mema o te rōpu rangahau. Ko ā ratou taipitopito kei tēnei pānui, me kore ra, me tuku īmēra atu kia rātou kei mumsleep@massey.ac.nz, me kore ra, me wāea atu kia rātou kei 0800 MUMSLEEP.

You can contact a member of the research team using their details provided on this information sheet, or email them at mumsleep@massey.ac.nz, or phone them on 0800 MUMSLEEP.

Me ka hiahia ahau ki te tangata uri reo, kei kona tētahi?
If I need an interpreter, can one be provided?
Kao. Ko te reta paewaho, ngā pārongo me te puka whakaae kei roto i te reo Māori. Ko ngā pātai rangahautanga kei roto i te reo pākeha. He tikanga ako tēnei kia tāea e koe te whakautu i ngā pātai i roto i te reo pākeha.

No. The cover letter, information sheet and consent form are available in Māori. Study questionnaires will be provided in English. It is a study requirement that you are able to complete the questions in English.

Ka tāea e koe te hari he hoa, me kore ra, ko tētahi o tō whānau hei tautoko i a koe kia mārama ai ngā tāpokopokotanga me nga hua o tēnei rangahautanga, me ētahi atu whakamāhukihuki ka hiahia koe.

You may have a friend, family or whānau support to help you understand the risks and/or benefits of this study and any other explanation you may require.

Auaka noa koe te whakautu i ngā pātai katoa kei te pepa pātai, me kore ra, te wāea tio,
ā ka tāea e koe te aukati i te wāea tio ahakoa te aha.

You do not have to answer all the questions in the questionnaires or the phone call, and you may stop the phone call at any time.

Me he pātai, me kore ra, he māharahara āu mō tō mana kaiuru i tēnei rangahautanga, tērā pea ka hiahia koe ki te whakapā atu ki tētahi kaitaunaki hauora motuhake me te hauātanga:
Wāea kore utu: 0800 555 050
Karere whakaahua kore utu: 0800 2 SUPPORT (0800 2787 7678)
Īmēra: whaitaua@hdc.org.nz

If you have any queries or concerns regarding your rights as a participant in this study, you may wish to contact an independent health and disability advocate:
Free phone: 0800 555 050
Free fax: 0800 2 SUPPORT (0800 2787 7678)
Email: advocacy@hdc.org.nz

Noho Matatapu
Confidentiality

- Kīhai he rauemi tuhi hei tautohu i a koe ake i roto i ngā ripoata katoa mō te rangahautanga.
- Kāore tō ingoa i runga i ngā pepa pātai. Inā hoki he nama tuhinga-ngaro kei a rātou, ā ka whakaputua ngā raraunga ki tētahi kāpata taonga toitū kei Te Pokapū Rangahau Moe/Oho o te Whare Wānanga o Massey.
- Kia oti ngā mahi o te raraunga kaupapa mahi ka rūnā purangatia mō ngā tau tekau.
- No material that could personally identify you will be used in any reports on the study.
- Questionnaires will not have your name on them. Instead they will have a code number and all data will be stored in a secure cabinet at Massey University's Sleep/Wake Research Centre.
- On completion of the project data will be archived securely for ten years.

Ngā Whakatau
Results

Ka whiwhi koe i te whakarāpopotonga o ngā otinga o te rangahautanga ā ka tāea e koe te tiki atu he tārua o ētahi o ngā pukapuka. Kia mataara ki te tōmuritanga o te kohinga raraunga me te tānga pukapuka o ngā whakatau. Ka oti tēnei rangahautanga i roto i nga ngā tau e toru, ā ka puta ngā whakatau i waenga i te tau 2012. Ka whakamahia e Ms Bronwyn Sweeney ētahi o ngā raraunga i roto i tāna tohu kairangi tuhinga whakapae.

You will receive a summary of the findings of the study and have access to a copy of any publications. Please be aware that there will be a delay between data collection and the publication of the results. This study will take 3 years to complete and the results will be available in mid 2012. Some of the data from this study will be used by Ms Bronwyn Sweeney in her PhD thesis.

Whanonga Pono
Ethics

Kua tau te whakaae matatika o te Hauora Pū me te Komiti Hauātanga Whanonga Pono, te nama whanonga pono (nama whakaaetanga:).

This study has received ethical approval from the Central Health and Disability Ethics Committee, ethics reference number (approval number: CEN/09/09/070).

Me aha ahau ināianei?
What do I do now?

Me ka waitohu koe ki te urutau ki te rangahautanga ā-muri i te pānui i tēnei puka pārongo, me whakakī koe i te puka whakaae kua āpitia me te pepa pātai (ā-tata tonu nei) me te pepa pātai (me kei waenganui kē koe i ngā wiki 35-37 o te haputanga). Me rau atu te puka whakaae me te pepa pātai ki te kōpaki whai-ingoa, ka whakahoki ki te rōpu rangahau.

If you choose to participate in the study after reading this information sheet, please complete the attached consent form and questionnaire. Please use the self-addressed envelope provided, and return the consent form and questionnaire to the research team. If you would prefer to complete the questionnaire via email, or over the telephone, please contact the research team by phoning 0800 MUMSLEEP (0800 686 7537) or by email at mumsleep@massey.ac.nz. **You will still need to return the signed consent form in the envelope provided**.

Tēna koe me tō kohuki kia uru atu koe ki te rangahautanga. Ka koakoa ngā mema o te rōpu rangahau ki te whakautu i o pātai mō tēnei rangahautanga, me kore ra, me tuku īmēra atu kia rātou kei mumsleep@massey.ac.nz, me kore ra, me wāea atu kia rātou kei 0800 MUMSLEEP.

Thank you for taking the time to consider being involved in the study. Any of the members of the research team would be happy to answer questions you may have about this study, or you can email them at mumsleep@massey.ac.nz, or phone them on 0800 MUMSLEEP (0800 686 7537).

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Mark.Huthwaite@otago.ac.nz

Dear Madam,

E Moe, Māmā Project

Maternal Sleep and Health in Aotearoa/New Zealand

Sleep is very important for our health. The Sleep/Wake Research Centre is a multi-disciplinary research team who are committed to improving the health, performance, safety, and well-being of New Zealanders through a better understanding of links between sleep and waking function. The members of the research team involved in this study from the Sleep/Wake Research Centre are Dr. Leigh Signal (Senior Research Officer and Principal Investigator), Dr. Sarah-Jane Paine (Tūhoe, Post-Doctoral Research Fellow), Ms. Bronwyn Sweeney (PhD student) and Professor Philippa Gander (Director). We are also working with Professor Kathy Lee (Professor in Nursing and Co-Director, Perinatal Nursing Program) from the University of California and Dr. Mark Huthwaite (Senior Lecturer and Psychiatrist) from the University of Otago, Wellington.

You are invited to take part in a study investigating sleep and maternal health in pregnant and postpartum women. Five hundred Māori and 500 non-Māori women will be invited to participate in this study as we will be using our data to look for differences by ethnicity.

We are currently trying to find out:

1. If there is a relationship between sleep duration and quality in late pregnancy and the duration of labour and type of birth women experience.
2. We are also investigating if there is a relationship between sleep duration and quality during late pregnancy and early postpartum and changes in postpartum mood.
3. We are also interested in understanding if there are other factors that might influence these relationships.

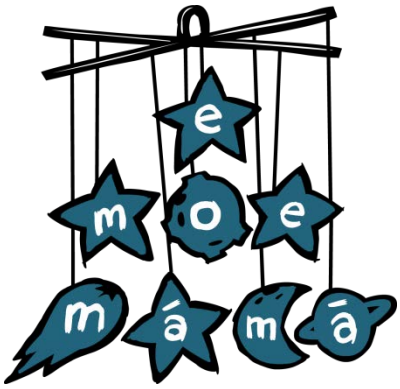
In this study pack you will find an information sheet that explains the study in more detail. If you choose to participate in the study after reading the information sheet, please complete the consent form and questionnaire. Please use the self-addressed envelope provided, and return the consent form and questionnaire to the research team.

You can contact any member of the research team directly with any concerns or queries about the survey at the address and phone numbers given.

Thank you for your consideration of this study.

Sincerely,

Encl (Consent form, Information sheet, Questionnaire, Post-paid return envelope)



CONSENT FORM

E Moe, Māmā Project

Maternal Sleep and Health in Aotearoa/New Zealand

If you have decided to participate in the study, please complete and return this consent form in the envelope provided as soon as possible. The questionnaire can be returned separately once you are between 35 and 37 weeks pregnant. We will send you a reminder and another return envelope.

- I have read and I understand the information sheet dated October 2009 for volunteers taking part in the study designed to investigate sleep and maternal health in pregnant and postpartum women. I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.
- I have had the opportunity to use whānau support or a friend to help me ask questions and understand the study.
- I understand that taking part in this study is voluntary (my choice), and that I may withdraw from the study at any time and this will in no way affect my health care.
- I understand that participation in this study is confidential and that no material that could identify me will be used in any reports on this study.
- I have had time to consider whether to take part in the study.
- I know whom to contact if I have any questions about the study.
- I wish to receive a copy of the results. YES ◯ NO ◯

  Please be aware that there will be a delay between data collection and the publication of the results. This study will take 3 years to complete and the results will be available in mid 2012.
- I consent to information related to the birth of my baby being made available by the maternity service where I give birth. YES ◯ NO ◯
- If any of the questionnaires suggest that I am at elevated risk for postnatal depression I consent to this information being sent to my Lead Maternity Carer, doctor or other health professional.

  YES ◯ NO ◯

  If **YES** please provide Lead Maternity Carer/doctor's name and location: _____

  _____

I (full name) _____ hereby consent to take part in this study.

Date _____ Signature _____

IMPORTANT: So that we know when and where to contact you for the postnatal part of the study, please complete the following:

Address: _____ Date baby is due: _____

_____ Phone (home): _____

_____ Cell phone: _____

_____ Postcode: _____

Email: _____

(preferably not a work email unless you will be accessing those emails after your baby is born)

A photocopy of the completed consent form will be returned to you.

MASSEY UNIVERSITY

Sleep/Wake Research Centre
Moe Tika, Moe Pai

Massey University – Wellington Campus
PO Box 756
Wellington 6140
New Zealand

Administration
+64 (0)4 380 0603

Study enquiry line
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October 2009

INFORMATION SHEET

E Moe, Māmā Project

Maternal Sleep and Health in Aotearoa/New Zealand

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You are invited to take part in a study investigating sleep and maternal health in pregnant and postpartum women.

Your participation is entirely voluntary (your choice). You do not have to take part in this study not to take part this will in no way affect your current or future care or treatment.

If you do agree to take part in the study, you are free to withdraw from the study at any time, without having to give a reason, and this will in no way affect your current or future care or treatment.

About the study

The aims of the study are to:

1. To investigate the relationship between sleep duration and quality during the third trimester of pregnancy and duration of labour/type of birth, and determine factors that might influence this relationship.

2. To investigate the relationship between sleep duration and quality during late pregnancy and early postpartum and changes in postpartum mood, and determine factors that might influence this relationship.

Participants

1000 pregnant women (500 Māori and 500 non-Māori) will be invited to participate in this study by their antenatal care provider or childbirth educator. Alternatively, women may contact the research team directly after seeing an advertisement for the study or after hearing about the study from someone else. Women must be 16 years of age or older and be able to complete a questionnaire in English.

Location and timing of the study

All study questions can be answered by you in your own time and in your own home. Your participation in the study will be over a 4 month period. The entire study will run for 3 years and be finished in the middle of 2012.

What is involved if you decide to participate?

If you decide to be in the study you will be asked to:

- Complete and return a questionnaire in weeks 35-37 of your pregnancy. The questionnaire takes approximately 30-40 minutes to complete.

- Complete a phone interview when your baby is about 6 weeks old. This will take about 10 minutes.

- Complete and return a final questionnaire approximately 12 weeks after birth. This questionnaire takes approximately 30-40 minutes to complete.

The information you provide in the Consent Form may be used to contact you via text, email or telephone, to remind you about questionnaire completion.

If you have given us permission, we will access information from the maternity service where you gave birth to obtain information such as the duration of your labour, type of birth (e.g. spontaneous vaginal, forceps, etc), and birth weight of your baby.

Benefits, risks and safety
If you choose to receive the results of the study, you will have an opportunity to learn about sleep and the changes to sleep that occur immediately before and after the birth of your child.

There is a minor inconvenience associated with the time required to complete the questionnaires. You will, however, be provided with a $20 voucher of your choice (petrol, supermarket or department store) when you return a completed questionnaire in late pregnancy and at 12 weeks postpartum. This is to reimburse you if you require a babysitter to provide you with enough time to complete the questionnaires.

General
Will my GP (doctor) and/or Lead Maternity Carer be told I am in the study?
Included in each questionnaire and the phone call is a scale to screen for postnatal depression. If the results of the scale suggest you may be at risk from this disorder then we will tell you. We will then suggest where you can go for further evaluation and treatment. If you choose, we will also notify your Lead Maternity Carer, GP or other health care provider.

Where can I get more information about the study?
You can contact a member of the research team using their details provided on this information sheet, or email them at mumsleep@massey.ac.nz, or phone them on 0800 MUMSLEEP.

If I need an interpreter, can one be provided?
No. The cover letter, information sheet and consent form are available in Māori. Study questionnaires will be provided in English. It is a study requirement that you are able to complete the questions in English.

You may have a friend, family or whānau support to help you understand the risks and/or benefits of this study and any other explanation you may require

You do not have to answer all the questions in the questionnaires or the phone call, and you may stop the phone call at any time.

If you have any queries or concerns regarding your rights as a participant in this study, you may wish to contact an independent health and disability advocate:
Free phone: 0800 555 050
Free fax: 0800 2 SUPPORT (0800 2787 7678)
Email: advocacy@hdc.org.nz

Confidentiality
No material that could personally identify you will be used in any reports on the study.
Questionnaires will not have your name on them. Instead they will have a code number and all data will be stored in a secure cabinet at Massey University's Sleep/Wake Research Centre.
On completion of the project data will be archived securely for ten years.

Results
You will receive a summary of the findings of the study and have access to a copy of any publications. Please be aware that there will be a delay between data collection and the publication of the results. This study will take 3 years to complete and the results will be available in mid 2012. Some of the data from this study will be used by Ms Bronwyn Sweeney in her PhD thesis.

Ethics
This study has received ethical approval from the Central Health and Disability Ethics Committee, ethics reference number (approval number: CEN 09/09/070).

What do I do now?
If you choose to participate in the study after reading this information sheet, please complete the attached consent form (as soon as possible) and questionnaire (if you are already between 35-37 weeks pregnant). Please use the self-addressed envelope provided, and return the consent form (and questionnaire) to the research team. If you would prefer to complete the questionnaire via email, or over the telephone, please contact the research team by phoning 0800 MUMSLEEP (0800 686 7537) or by email at mumsleep@massey.ac.nz. **You will still need to return the signed consent form in the envelope provided**.

Thank you for taking the time to consider being involved in the study. Any of the members of the research team would be happy to answer questions you may have about this study, or you can email them at mumsleep@massey.ac.nz, or phone them on 0800 MUMSLEEP (0800 686 7537).

Appendix 3: Letter of ethical approval

Health and Disability Ethics Committees

Central Regional Ethics Committee
Ministry of Health
Level 2, 1–3 The Terrace
PO Box 5013
Wellington
Phone: (04) 496 2405
Fax: (04) 496 2191
Email: central_ethicscommittee@moh.govt.nz

2 November 2009

[Amendment to letter dated 20 October 2009]

Dr Leigh Signal
Sleep/Wake research Centre
Massey University
102 Adelaide Road
Newtown
Wellington

Dear Dr Leigh Signal

CEN/09/09/070 - SLEEP DURING PREGNANCY AND POSTPARTUM: THE RELATIONSHIP WITH MATERNAL HEALTH

The above study has been given ethical approval by the Central Regional Ethics Committee pending receipt of locality assessments for Capital and Coast District Health Board, and for Parent Centre and local public health organisations

Approved Documents

- Information Sheet : Maternal Sleep and Health in Aotearoa/New Zealand, version 6, 06/10/2009.
- Consent Form Maternal Sleep and Health in Aotearoa/New Zealand, version 3, 06/10/2009.
- Information Sheet: PIPIS Project: Sleep and Health in New Mothers and their Babies in Aotearoa/New Zealand, version 3, 05/10/2009.
- Consent Form: PIPIS Project: Sleep and Health in New Mothers and their Babies in Aotearoa/New Zealand, version 3, dated 05/10/2009.
- Postal Sleep Questionnaire : Sleep and Health During Pregnancy, version 5, dated 05/10/2009.
- Cover letter to Maori participants. E Moe, Māmā : Moe Kahurangi Me te Haurora I Aotearoa, version 2, dated 06/10/2009.
- Information sheet. E Moe, Māmā : Moe Kahurangi Me te Haurora I Aotearoa, version 2, dated 19/08/2009.
- Amendment to postal sleep questionnaire: questions B8 and E3.
- Cover letter for non- Maori participants, version 1, 19/08/09
- Consent form: Puka Whakaae (consent form for Maori participants), version 2, 06/01/09
- Cover letter PIPIS Project, version 1, 24/08/09
- Questionnaire 1 for Behavioural-Education Intervention (all women), version 1, 23/08/09
- Questionnaire 2 for Behavioural-Education Intervention (intervention and control group versions), version 1, 23/08/09.
- Questionnaire 3 for Behavioural-Education Intervention (intervention and control group versions), version 1, 23/08/09.
- Sleep diary for Behavioural-Education Intervention (mother and infant versions), version 1, 23/08/09.
- Sleep diary and actiwatch information sheet for Behavioural Education Intervention, version 1, 24/08/09
- Feedback form for Behavioural-Education Intervention (intervention and control group versions), version 1, 24/08/09

Accreditation
The Committee involved in the approval of this study is accredited by the Health Research Council and is constituted and operates in accordance with the Operational Standard for Ethics Committees, April 2006.

Progress Reports
The study is approved until **1 October 2012**. The Committee will review the approved application annually and notify the Principal Investigator if it withdraws approval. It is the Principal Investigator's responsibility to forward

a progress report covering all sites prior to ethical review of the project in **14 October 2010**. The report form is available on http://www.ethicscommittees.health.govt.nz. Please note that failure to provide a progress report may result in the withdrawal of ethical approval. A final report is also required at the conclusion of the study.

Amendments
It is also a condition of approval that the Committee is advised if the study does not commence or is altered in any way, including documentation eg advertisements, letters to prospective participants.

Please quote the above ethics committee reference number in all correspondence.

The Principal Investigator is responsible for advising any other study sites of approvals and all other correspondence with the Ethics Committee.

It should be noted that Ethics Committee approval does not imply any resource commitment or administrative facilitation by any healthcare provider within whose facility the research is to be carried out. Where applicable, authority for this must be obtained separately from the appropriate manager within the organisation.

Yours sincerely

SScott

Sonia Scott
Central Regional Ethics Committee Administrator

Email: sonia_scott@moh.govt.nz

Appendix 4: High scoring EPDS protocol
Phone call guidelines for high scorers

Before calling the participant, make sure you check their responses to other relevant questions to provide you with some context:

Q15. Supports

Q34.Worry Index

Q40-45. Mood *e.g., they may have already sought professional help and then you can follow-up to see how this is going.*

Q53. Life events – recent stressors in their lives

For 4 – 6 week and Q3 calls, I also photocopy their consent form (located in dark blue filing cabinet in my office by Meg's desk) and any notes from previous high EPDS calls made, so I am aware of their situation. NB: Q1 should have a copy of consent attached already.

Introduction

Hi, my name is _____ from Massey University and I am ringing about the Sleep & pregnancy questionnaire/phone survey that you recently completed.

Purpose of call

"Within the questionnaire/phone survey we have a series of questions about mood and anxiety, using a standardised screening tool. Your total score on these questions was high/elevated. This does not necessarily mean that you are depressed, sometimes it can be due to things going on around the time you are answering the questions or other recent stresses in your life. You are probably the best person to know how you have generally been feeling." "How does this high score fit with how you have been feel lately?"

NB: as the conversation continues, can add more details i.e. that the screening tool is called the Edinburgh Postnatal Depression Scale (EPDS); that scores can be from 0 – 30 and your score was __; ask about the level of support the person has at home; **important to reiterate that this is a screening tool only and we are NOT saying you have depression.**

If they are concerned → "We (highly) recommend you let your LMC/midwife/GP know, and they can provide further assessment and advice if required.

Letters

Would it be helpful if we put that information in a letter for you and you could take it along to your GP or show your midwife?

We can also try and get in contact with you Midwife/GP and write to let them know, so that they can follow-up with you.

Consent Form: I see that on your consent form that you have ticked ____, I am wondering whether that is still the case.

Edinburgh Postnatal Depression Scale (EPDS):
Phone Call Protocols for elevated scores.

When phoning women, keep in mind they may find this information distressing.

35-37 Week Antenatal EPDS & 12 Week Postnatal

Criteria	Action
EPDS Score ≥ 13 & Q10= '0' or '1'	**Participant** 1. Call participant to inform of high/elevated score, which may indicate symptoms of depression. 2. Advise that they she should discuss this further with her LMC/GP. 3. Follow-up regarding consent to contact LMC. 4. Send letter to woman if requested EPDS_Letter to Participant_35_37wks.doc; EPDS_Letter to Participant_12 week post.doc EPDS_Letter to Participant_6 week post.doc **Midwife/LMC/GP** 1. If consent obtained, phone LMC to advise of elevated scores and that they may want to re-administer the EPDS and consider a referral for further evaluation/treatment: *<u>If EPDS≥ 18</u> discuss possible referral to Maternal Mental Health Service. If they are unsure on the process they can consult with Mark Huthwaite/Sam McBride/Fiona Martin.* *<u>If EPDS 13-17</u> consider referral to a PHO/NGO service, generally via their GP.* 2. Send Letter to Midwife/LMC/GP EPDS_Letter to LMC or GP.doc EPDS_Letter to LMC or GP_12 Week Post.doc
EPDS Score ≥ 13 & Q10= '2' or '3' OR Any EPDS score and Q10='2' or '3'	• Discuss with Mark (in his absence Fiona/Sam) initially ↓ • Phone call to participant to inform of elevated score/risk on Q10. Advise that we highly recommend she should discuss this further with her LMC/GP and get consent to inform LMC/GP. ↓ • Phone LMC/GP to inform of elevated scores and potential risk. Advise that they may want to re-administer the EPDS and further assess. Also, consider a referral for further evaluation/treatment. Discuss possible referral to Maternal Mental Health Service and in any emergency/urgent situation the first point of contact 111 and/or Crisis Assessment Treatment Team. If they are unsure they can consult further with Mark Huthwaite/Sam McBride/Fiona Martin. ↓ • Send letter to woman (discuss this first) & LMC/GP. *EPDS_Letter to LMC or GP_elevated risk Q10.doc*

Elevated score on Brief Measure of Worry Scale	If high scores are identified on this scale it should correlate with the EPDS score. ↓ Review any discrepancies in scores with Mark.
If the woman advises that she requires/may require acute assistance.	Provide CATT team number/Mental Health Crisis Line number (see Appendix 1). Let them know they may have to leave a message. ↓ Also inform Midwife
Emergency or urgent situation	Call 111

6-Week Phone call*

Criteria	**Action**
EPDS-3 ≥ 4	• Phone call to participant to inform of elevated score, which may indicate symptoms of depression. Advise that they she should discuss this further with her LMC/GP. ↓ Phone LMC (if consented) to advise of elevated scores and that they may want to re-administer the EPDS and consider a referral for further evaluation/treatment. If EPDS-3 >5 discuss possible referral to Maternal Mental Health Service. If they are unsure on the process they can consult with Mark. If EPDS 4-5 consider referral to a PHO/NGO service. ↓ Send letter to woman & LMC/GP <<letter.doc>>.
If women advises that she requires acute/after hours assistance	Provide Mental Health line number or CATT team number. They may have to leave a message. Also inform LMC/GP.

* Note: At 6 week phone call woman are no longer under the care of LMC and may not be registered with a GP – discuss with woman how we may facilitate access to an appropriate service.

Adjusted EPDS-3 Scores

EPDS-3 scores	0	1	2	3	4	5	6	7	8	9
Adjusted EPDS-3 scores	0	3	7	10	13	17	20	23	27	30

(Protocol) Appendix 1

Crisis Assessment Treatment Teams

They provide 24 hour emergency care and assessments for people in psychiatric crisis as well as providing information about the support services available. Women can phone directly

- **MENTAL HEALTH CRISIS LINE** - 0800 745 477
- **CCDHB** – 494 9169 - When you phone the service you may get an answer phone – leave your phone number and name and they will get back to you, usually within 15 minutes http://www.ccdhb.org.nz/planning/Mental_Health/services/CATT.htm
- **HVDHB** - Ph (04) 566-6999 ask for the CAT Team -. http://www.huttvalleydhb.org.nz/Article.aspx?ID=808
- **Wairarapa** - 0800 946 9800
- **Manawatu (Palmerston North)** – 0800 653-357
- **Hawkes Bay** – 0800 112 334
- **Waitemata (Waitakere, North Shore & Rodney)** – (09) 486 8900 or 0800 809 343
- **Central Auckland** – 0800 800 717
- **South Auckland** – (09) 270 4742
- **Christchurch** – 0800 920 092 or (03) 364 0482
- **Dunedin** – (03) 474 0999 – this is Dunedin Hospital number. Ask for the Emergency Psychiatric Service. They will contact the Central Otago on-call worker.

Telephone Support Services - 24 Hours

Sometimes it is easier to talk to an anonymous person, and/or you may feel the need for some immediate support, without having to go out to obtain it. There is a range of different telephone support services available, such as:

- Lifeline -Free Phone: 0800 543 354
- MAMTA (Asian women supporting Asian women) -Phone: 04 478 6213
- National Healthline - Free Phone: 0800 611 116
- Plunketline : 0800 933 922
- Pregnancy Counselling Services - 0800 633 328
- Samaritans - Phone: 04 473 9739
- SIDS (Sudden Infant Death Syndrome) offer a 24-hour phone support line for parents bereaved by cot death. Free Phone: 0800 164 455
- Parent Help - for parent help and family support - offer 24-hour telephone support, counselling, and an anger change group for women.
  Phone: 04 499 9994

Useful Websites

www.mothersmatter.co.nz
www.outoftheblue.org.nz - Depression website, part of Mental Health Foundation
www.mentalhealth.org.nz - Mental Health Foundation website
www.parentscentre.org.nz - Good sections on mental health
www.everybody.co.nz - Health information for New Zealanders. Only small section on PND
www.webhealth.co.nz - Regional based health & social service organisations
www.pnpsupport.org.nz Auckland based postnatal psychosis support group
www.matatini.co.nz - Maori mental health website
www.psychiatry.net.nz - Summary of articles in psychiatric journals
www.pnd.org.nz - Wellington based support group, excellent articles
www.sfnat.org.nz - Supporting families in Mental Illness, regional supports
www.postnataldistress.org.nz - Auckland based support website and groups
www.tabs.org.nz - Trauma and birth stress-PTSD after childbirth
www.everybody.co.nz/supportgroups.aspx - Listings of support groups in NZ
www.justbreathe.org.nz - Christchurch based support website

MENTAL HEALTH SERVICES/RESOURCES

DHB Services

Maternal Mental Health Services - CCDHB

*For women with a moderate-severe mood or psychotic disorder, living in the greater Wellington region (**Kapiti, Porirua, Wellington, and Hutt Valley areas**), this is likely to involve direct contact with us. For those with mild-moderate disorders, or living in the Lower Central North Island (**Gisborne, Hawkes Bay, Wanganui, Manawatu, and Wairarapa**), we provide a consultation/liaison service via other health providers involved in the care of the mother.*

How to access the service: Referrals are accepted from GPs and midwives, and other mental health and hospital services. If you would like further information about our service talk to your midwife, doctor or a local community mental health team.21 Hania Street, Mt. Victoria, Wellington **Phone:** (04) 801 2960

Mental Health Access Centre – Wairarapa DHB

The Mental Health Access Centre provides a single point of contact for urgent and non urgent new referrals, consultation, liaison and education regarding mental health.

For crisis and non urgent referrals, consultation, information and advice about mental health
Free Phone: 0508 432 432
The service is available to all people and their whanau/family living in the Wairarapa region.

Maternal Mental Health Specialist Service – Mid-Central Region
To provide clinical assessment, short-term intervention and co-ordination of services for women (their babies, partners and familes/whanau and significant others) who are pregnant or up to 9 months postnatal at point of referral with an associated moderate to severe mental illness (psychosis or mood disorder).

Ruahine Building
Palmerston North Hospital
Midcentral District Health Board
Tel: 06 350 8184

Maternal Mental Health Service - Goodhealth Wanganui
A community-based service which includes: assessment and treatment.
Referrals are accepted from primary practitioners, midwives, obstetricians, maternity staff, mental health services and in some cases Plunket.

Community Mental Health Service
Wanganui Base Hospital
Private Bag 3003
Wanganui

Mark Huthwaite, Consultant Psychiatrist, Maternal Mental Health Service, CCDHB

Mobile: 021 300182, Tel: (04) 8012960 or (04) 3855541 ext 5545

Fiona Martin, Community Psychiatric Nurse, Maternal Mental Health Service, CCDHB

Tel: (04) 8012960

Appendix 5:
Sleep and Health during Pregnancy Questionnaire

Sleep and Health during Pregnancy

THIS QUESTIONNAIRE SHOULD BE COMPLETED WHEN YOU ARE 35-37 WEEKS PREGNANT

1. What is <u>your</u> date of birth? ..... **/** ..... **/** .....
(day) (month) (year)

2. When is <u>your baby</u> due? ..... **/** ..... **/** .....
(day) (month) (year)

3. How many weeks pregnant are you now? ..... weeks

4. Write your NHI number here if you know it:
(This is your National Health Index number – your midwife or doctor will have this).

5. Which ethnic group do you belong to? *Mark the space or spaces which apply to you.*

❍ New Zealand European
❍ Māori
❍ Samoan
❍ Cook Island Māori
❍ Tongan
❍ Niuean
❍ Chinese
❍ Indian
❍ Other such as DUTCH, JAPANESE, TOKELAUAN. Please state: .....

6. Where do you usually live?

Street number..... Flat number.....

Street name .....

Suburb or rural locality ..... Post Code.....

City, town or district .....

Telephone number..... Cell phone number.....

7. In the last 12 months what was your <u>households</u> total income, before tax or anything else was taken out of it?

1❍ Loss
2❍ Zero income
3❍ $1 - $5,000
4❍ $5,001 - $10,000
5❍ $10,001 - $15,000
6❍ $15,001 - $20,000
7❍ $20,001 - $25,000
8❍ $25,001 - $30,000
9❍ $30,001 - $35,000
10❍ $35,001 - $40,000
11❍ $40,001 - $45,000
12❍ $45,001 - $50,000
13❍ $50,001 - $70,000
14❍ $70,001 – $100,000
15❍ $100,001 - $150,000
16❍ $150,001 or more
17❍ don't know

Please go to next page ☞

Paid Work (These questions refer to your work in the **last month**)

8. Do you currently work for pay, profit or income?

1❍ Yes, one paid job 2❍ Yes**,** more than one paid job

0❍ No *Comments welcome* →

If you answered 'No' please go to question 12, if 'Yes' go to question 9.

9. On average, how many HOURS A WEEK did you work for pay, profit or income? Just think about the LAST MONTH.

Please write how many hours a week here →..... hours a week

10. In the LAST MONTH did you work for pay, profit or income for at least 3 hours between midnight and 5am?

1❍ Yes 0❍ No *(please go to question 12)*

11. In the LAST MONTH what is the total number of nights that you worked for at least 3 hours between midnight and 5am? *Please write how many nights here* →..... nights

12. Return to work

1❍ I have no plans to return to work

2❍ I plan to return to work but have no date in mind

3❍ I expect to be back at work when my baby is ..... *(write baby's age)*

Support & dependents

13. How many people normally live in your home?.....

14. How many of these people need looking after by you (not counting you)**?**.....

What are their ages? .....

15. Support for you at home

Do you live with anyone you can count on to help you with:

Financial support 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Emotional support (e.g. someone who listens or is 'there' for you) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Advice (e.g. can give information or guidance about pregnancy, birth and parenting) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Concrete/Practical support (e.g. baby care, housework, cooking) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Please go to next page ☞

16. Support for you – outside of home

Are there other people, not living with you, who you can count on to help with:

Financial support 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Emotional support (e.g. someone who listens or is 'there' for you) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Advice (e.g. can give information or guidance about pregnancy, birth and parenting) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Concrete/Practical support (e.g. baby care, housework, cooking) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Pregnancy can affect how we feel about relationships. We are interested to know how you feel about your relationship with your partner right now. We understand that this may not be how you usually feel. If you do not have a partner please go to Question 19.

17. If you have a partner, how is your relationship with them at the moment?

Please circle one number

Perfectly Happy — Extremely Unhappy **OR** 8❍ Not applicable

0 1 2 3 4 5 6 7

18. How supportive of this pregnancy is your partner?: *Please circle one number*

Completely supportive — Not at all supportive **OR** 8❍ Not applicable

0 1 2 3 4 5 6 7

19. How often is a private motor vehicle (not counting motorbikes) available for your use?

	NO DAYS						EVERY DAY
Circle the number of days a week	0	1	2	3	4	5	6	7

Sleep – before this pregnancy

20. <u>Before this pregnancy</u>, how many hours sleep did you usually get in 24 hours, including naps?

Please write the number of hours here ..... hours

21. <u>Before this pregnancy</u>, how often did you get a good night's sleep?

	NO NIGHTS						EVERY NIGHT
Circle the number of nights	0	1	2	3	4	5	6	7

Please go to next page ☞

22. <u>Before this pregnancy</u>, has anyone told you that during sleep you do any of the following things?
Please circle how often

	NO NIGHTS							EVERY NIGHT
Loud snoring	0	1	2	3	4	5	6	7
Long pauses between breaths while asleep	0	1	2	3	4	5	6	7
Legs twitching or jerking while you sleep	0	1	2	3	4	5	6	7

Sleep – during this pregnancy

23. How many hours sleep do you usually get in 24 hours, including naps?
(Just think about the <u>last week</u>).

Please write the number of hours here ..... hours

24. In the <u>last week</u>, how often did you get a good night's sleep?

	NO NIGHTS							EVERY NIGHT
Circle the number of days	0	1	2	3	4	5	6	7

25. On how many days in the last week did you have a daytime nap?

	NO NIGHTS							EVERY NIGHT
Circle the number of days	0	1	2	3	4	5	6	7

26. How long on average, per day, do you spend outside (really outside) exposed to daylight?
..... hours ..... minutes

27. On how many nights in the last week did the following things disturb your sleep?

Please circle one number in every row.

	NO NIGHTS							EVERY NIGHT
Circle the number of nights								
Going to the bathroom	0	1	2	3	4	5	6	7
Pain in back/neck/joints	0	1	2	3	4	5	6	7
Dreams	0	1	2	3	4	5	6	7
Nightmares	0	1	2	3	4	5	6	7
Heartburn	0	1	2	3	4	5	6	7
Nasal congestion (blocked nose)	0	1	2	3	4	5	6	7
Leg cramps	0	1	2	3	4	5	6	7
Contractions	0	1	2	3	4	5	6	7
Feeling too hot or cold	0	1	2	3	4	5	6	7
Thinking or worrying about things	0	1	2	3	4	5	6	7
Baby moving around (baby kicking)	0	1	2	3	4	5	6	7
Other children	0	1	2	3	4	5	6	7

Please go to next page ☞

Circle the number of nights	NO NIGHTS							EVERY NIGHT
Just can't get comfortable	0	1	2	3	4	5	6	7
Just can't get to sleep	0	1	2	3	4	5	6	7
Disturbed by partner (e.g. snoring)	0	1	2	3	4	5	6	7
Other	0	1	2	3	4	5	6	7

If you circled '**Other'**, what were the other things that disturbed your sleep?

28. During sleep in the <u>LAST WEEK</u>, has anyone told you that you did any of the following? *Please circle how often*.

Circle the number of nights	NO NIGHTS							EVERY NIGHT
Loud snoring.....	0	1	2	3	4	5	6	7
Long pauses between breaths while asleep	0	1	2	3	4	5	6	7
Legs twitching or jerking while you sleep	0	1	2	3	4	5	6	7

29. Do you ever experience an urge to move your legs (usually accompanied by unpleasant sensations)?

1❍ Yes 0❍ No – *if "No" please go to question 31.*

30. If you answered "Yes" in question 29, is this: *Tick all that apply to you.*

1❍ Worse at night?

2❍ More noticeable when you rest?

3❍ Relieved by movement?

31. How often in the <u>last week</u> did you:

Please circle one number in every row	NO NIGHTS							EVERY NIGHT
Have difficulty getting to sleep	0	1	2	3	4	5	6	7
Wake up during your sleep period.....	0	1	2	3	4	5	6	7
Wake up too early at the end of a sleep period.....	0	1	2	3	4	5	6	7
Feel rested upon awakening at the end of a sleep period	0	1	2	3	4	5	6	7
Sleep poorly	0	1	2	3	4	5	6	7
Feel sleepy during the day	0	1	2	3	4	5	6	7
Struggle to stay awake during the day.....	0	1	2	3	4	5	6	7
Feel irritable during the day.....	0	1	2	3	4	5	6	7
Feel tired or fatigued during the day	0	1	2	3	4	5	6	7
Feel satisfied with the quality of your sleep	0	1	2	3	4	5	6	7

Please go to next page ☞

Please circle one number in every row	NO NIGHTS							EVERY NIGHT
Feel alert and energetic during the day	0	1	2	3	4	5	6	7
Get too much sleep	0	1	2	3	4	5	6	7
Get too little sleep	0	1	2	3	4	5	6	7
Take a nap at a scheduled time	0	1	2	3	4	5	6	7
Fall asleep at an unscheduled time	0	1	2	3	4	5	6	7
Use a prescription sleeping pill to help you get to sleep	0	1	2	3	4	5	6	7
Use any pain medication to help you get to sleep (e.g. Panadol)	0	1	2	3	4	5	6	7
Take or use anything else to help you sleep	0	1	2	3	4	5	6	7

If so, what did you take or use:

32. How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? *This refers to your usual way of life in recent times.*

PLEASE TICK ONE CIRCLE ON EACH LINE

	would never doze	slight chance	moderate chance	high chance
Sitting and reading	0❍	1❍	2❍	3❍
Watching TV	0❍	1❍	2❍	3❍
Sitting inactive in a public place (e.g. movies, meeting)	0❍	1❍	2❍	3❍
As a passenger in a car for an hour without a break	0❍	1❍	2❍	3❍
Lying down in the afternoon when circumstances permit	0❍	1❍	2❍	3❍
Sitting and talking to someone	0❍	1❍	2❍	3❍
Sitting quietly after a lunch <u>without</u> alcohol	0❍	1❍	2❍	3❍
In a car, while stopped for a few minutes in traffic	0❍	1❍	2❍	3❍

PLEASE MAKE SURE YOU HAVE TICKED ONE BOX ON EACH LINE

Feelings in pregnancy

33. Please tick the answer which comes closest to how you have felt <u>IN THE LAST 7 DAYS</u>, not just how you feel today.

I have been able to laugh and see the funny side of things.

0❍ As much as I always could
1❍ Not quite so much now
2❍ Definitely not so much now
3❍ Not at all

I have looked forward with enjoyment to things.

0❍ As much as I ever did
1❍ Rather less than I used to
2❍ Definitely less than I used to

Please go to next page ☞

3❍Hardly at all

I have blamed myself unnecessarily when things went wrong.
3❍Yes, most of the time
2❍Yes, some of the time
1❍Not very often
0❍No, never

I have been anxious or worried for no good reason.
0❍No, not at all
1❍Hardly ever
2❍Yes, sometimes
3❍Yes, very often

I have felt scared or panicky for no very good reason.
3❍Yes, quite a lot
2❍Yes, sometimes
1❍No, not much
0❍No, not at all

Things have been getting on top of me.
3❍Yes, most of the time I haven't been able to cope at all
2❍Yes, sometimes I haven't been coping as well as usual
1❍No, most of the time I have coped quite well
0❍No, I have been coping as well as ever

I have been so unhappy that I have had difficulty sleeping.
3❍Yes, most of the time
2❍Yes, sometimes
1❍Not very often
0❍No, not at all

I have felt sad or miserable.
3❍Yes, most of the time
2❍Yes, quite often
1❍Not very often
0❍No, not at all

I have been so unhappy that I have been crying.
3❍Yes, most of the time
2❍Yes, quite often
1❍Only occasionally
0❍No, never

The thought of harming myself has occurred to me.
3❍Yes, quite often
2❍Sometimes
1❍Hardly ever
0❍Never

Please go to next page ☞

34. The following are statements about worrying. Please read each statement and indicate how true each one is in describing your general/usual experience of worrying.
Please tick the one option that most likely applies to you for each statement

When I worry, it interferes with my day-to-day functioning (e.g. stops me getting my work done, organising myself or my activities).

0❍ **Not true at all** 1❍ **Somewhat true** 2❍ **Moderately true** 3❍ **Definitely true**

When I think I should be finished worrying about something, I find myself worrying about the same thing, over and over.

0❍ **Not true at all** 1❍ **Somewhat true** 2❍ **Moderately true** 3❍ **Definitely true**

My worrying leads me to feel down and depressed.

0❍ **Not true at all** 1❍ **Somewhat true** 2❍ **Moderately true** 3❍ **Definitely true**

When I worry, it interferes with my ability to make decisions or solve problems.

0❍ **Not true at all** 1❍ **Somewhat true** 2❍ **Moderately true** 3❍ **Definitely true**

I feel tense and anxious when I worry.

0❍ **Not true at all** 1❍ **Somewhat true** 2❍ **Moderately true** 3❍ **Definitely true**

I worry that bad things or events are certain to happen.

0❍ **Not true at all** 1❍ **Somewhat true** 2❍ **Moderately true** 3❍ **Definitely true**

I often worry about not being able to stop myself from worrying.

0❍ **Not true at all** 1❍ **Somewhat true** 2❍ **Moderately true** 3❍ **Definitely true**

As a consequence of my worrying, I tend to feel emotional unease or discomfort.

0❍ **Not true at all** 1❍ **Somewhat true** 2❍ **Moderately true** 3❍ **Definitely true**

This pregnancy and birth

35.Who is providing professional health care for you in this pregnancy?

❍ Independent (self-employed) midwife/team
❍ Hospital based midwife/team
❍ Hospital high risk team
❍ Specialist Obstetrician
❍ Shared care (e.g. midwife & obstetrician, midwife & GP)
❍ No one
❍ Other *(who)*_____

36. What was your weight before this pregnancy? ..... kgs **OR** ..... stones ..... lbs

37.What is your height? .....cms **OR** .....feet .....inches

38. When you got pregnant, were you trying to get pregnant?

1❍ Yes 0❍ No

39. Did you require the assistance of reproductive technology to become pregnant this time?

(e.g. IVF, GIFT, ICSI) 1❍ Yes 0❍ No

Please go to next page ☞

Mood

40. **<u>Before this pregnancy</u> did you ever have a period of 2 weeks or more when you felt particularly miserable or depressed?**

1❍ Yes 0❍ No – *go to question 41*

If so, did being depressed:

a) Interfere with your ability to get things done or your relationships with family and friends?
Circle one number

Not at all		Somewhat			Very much
0	1	2	3	4	5

b) Lead you to seek professional help?

1❍ Yes 0❍ No

41. **Have you ever been told by a health professional you were depressed or needed antidepressants?**

1❍ Yes 0❍ No

42. **<u>During this pregnancy</u> have you been distressed by feelings of anxiety or depression for 2 weeks or more?**

1❍ Yes 0❍ No– *go to question 43*

If so, did this distress:

a) Interfere with your ability to get things done or your relationships with family and friends?
Circle one number

Not at all		Somewhat			Very much
0	1	2	3	4	5

b) Lead you to seek professional help?

1❍ Yes 0❍ No

43. **Before this pregnancy, have you ever had depression during pregnancy** (antenatal depression) **or after having a baby** (postnatal depression)**?**

1❍ Yes 0❍ No

44. **Has anyone in your family ever been told by a health professional that they have depression or another mental health problem?**

1❍ Yes 0❍ No

If '**Yes'** who was that:……

45. **Has anyone in your family ever had antenatal or postnatal depression?**

1❍ Yes 0❍ No

If '**Yes**" who was that: ……

Please go to next page ☞

Pregnancy history

46. How many times have you ever been pregnant, including this one? ..... times
Comments welcome →

If this is your <u>first pregnancy</u>, please go to Question 50. If you have been pregnant more than once please answer the following:

47. How many times have you given birth to a baby, alive or not, after at least 20 weeks of pregnancy?
Comments welcome →

48. Have any of your previous babies had significant health problems which were identified in pregnancy or at birth?
1❍ Yes 0❍ No *Comments welcome →*

49. Have you had a caesarean section in the past?
1❍ Yes 0❍ No

50. Are you currently having <u>any treatment or monitoring</u> for any of these conditions?
Please tick one circle on every line.

	Yes	No	Don't know/ can't remember
High blood pressure (including hypertension, pre-eclampsia, toxaemia, chronic hypertension)	1❍	0❍	2❍
Pregnancy or pre-existing diabetes (gestational diabetes managed using dietary control, with or without insulin)	1❍	0❍	2❍
Low iron or anaemia	1❍	0❍	2❍
Abnormal vaginal bleeding	1❍	0❍	2❍
Placenta/whenua low down near the cervix (placenta praevia/low lying placenta)	1❍	0❍	2❍

Please go to next page ☞

51. Are you currently having <u>any treatment or monitoring</u> for any other conditions such as:
If 'No' please go to question 52

Other medical problem(s) – please specify (e.g.thyroid problem, severe back problem, severe carpal tunnel syndrome, any other medical condition):

Mental health problem(s) – please specify (e.g. depression, bipolar disorder, schizophrenia, or other mental health condition):

A diagnosed sleep disorder – please specify:

52. Please list any medicines you are currently taking.

Life events

53. This question is about things that may have happened during the last 12 months.
Tick all that apply to you - if none of these apply please go to question 54

- ❍ A close family member was very sick and had to go into hospital
- ❍ I broke up with, got separated or divorced from my partner
- ❍ I moved to a new address
- ❍ I was homeless
- ❍ My partner lost their job
- ❍ I lost my job even though I wanted to go on working
- ❍ I argued with my partner more than usual
- ❍ My partner said they did not want me to be pregnant
- ❍ I had a lot of bills I couldn't pay
- ❍ I was in a physical fight
- ❍ My partner or I went to jail
- ❍ Someone very close to me had a bad problem with drinking or drugs
- ❍ Someone very close to me died

Please go to next page ☞

54. Do you describe yourself as a: *Please tick the circle that applies to you*

3❍ regular smoker (I smoke one or more cigarettes per day)

2❍ occasional smoker (I do not smoke every day)

1❍ ex-smoker (I used to smoke but not any more)

0❍ non-smoker (I have never smoked regularly)

55. During this pregnancy how often do you drink alcohol? *Please tick the circle that applies to you*

0❍	1❍	2❍	3❍	4❍
Never	Less than once a week	Once every 3-7 days	Once every 2 days	Daily

56. On a typical drinking occasion (in this pregnancy), how many drinks do you have? (One drink equals a glass of beer or a glass of wine or a nip of spirits)? *Please tick the circle that applies to you*

0❍	1❍	2❍	3❍	4❍
None	Less than 2 drinks	2 to 4 drinks	5 to 6 drinks	More than 6 drinks

57. During this pregnancy how often do you use street or recreational drugs, including party pills? *Please tick the circle that applies to you*

0❍	1❍	2❍	3❍	4❍
Never	Less than once a week	Once every 3 to 7 days	Once every 2 day	Daily

58. Date questionnaire completed ..... **/** ..... **/** .....
(day) (month) (year)

Please take a moment now to flick through every page of this survey and check that you have answered all the questions you meant to.

A $20 voucher, from the choice of three options, below will be posted to you when we receive this completed questionnaire. Please ensure you advise us if your address changes.

Please indicate the type of voucher you would prefer (tick one):

Petrol ☐ (MTA) Supermarket ☐ (New World) Department store ☐ (Farmers)

Return questionnaire to Sleep/Wake Research Centre, Massey University, PO Box 756, Wellington 6140.

Important note

If you feel concerned about *any* of the issues raised by completing this questionnaire, we suggest that you discuss these with your Lead Maternity Carer, doctor or other health professional.

The end – Thank You.

E Moe, Māmā – 4-6 weeks postpartum telephone survey

Participant ID: ___ ___ ___ ___ EDD: _____/_____/_____

Date this survey **completed**: _____/_____/_____

Time survey was **completed:** _____

EPDS score Q1: _____

What date was your baby born on?	
So their age now is…	
And where did you give birth?	
Three questions now about **your** sleep in the last 24 hours:	
1. In the last 24 hours, how many 'sleep periods' have you had – so what that means is, in the last 24 hours, how many times have you gone to sleep – including naps. "	
2. So in total, how much sleep have you had in the last 24 hours?	
3. Quality of sleep: how would you rate the quality of your sleep in the last 24 hours? Note comments here:	0- very good 1- good 2- poor 3- very poor
Now we have three questions about how you have been feeling in the last 7 days – you have already answered questions like these in the first questionnaire. I will read you a statement and then ask you to choose from 4 response options.	
1. I have blamed myself unnecessarily when things went wrong.	3 Yes, most of the time 2 Yes, some of the time 1 Not very often 0 No, never
2. I have been anxious or worried for no good reason.	0 No, not at all 1 Hardly ever 2 Yes, sometimes 3 Yes, very often
3. I have felt scared or panicky for not very good reason.	3 Yes, quite a lot 2 Yes, sometimes 1 No, not much 0 No, not at all
Follow up required Y / N	**EPDS Total**

Is there anything else you would like to know about the study, or that you would like to tell us?
(Continue on back of sheet if required).

E Moe, Māmā – Contact Log
Four to Six-weeks postpartum telephone survey questions

Participant ID: ___ ___ ___ ___

Name:.....

Home Phone:.....

Cell Phone:.....

Notes:.....

.....

.....

Intro self.

"You are enrolled in our study of sleep changes in pregnancy and after birth, and we have received the first questionnaire from you. Thank you. Do you have 3-4 minutes now to answer a few short questions?

CALLING RECORD

Date	Time	# Called	Code	Notes	Staff

CODES:

BU	busy (phone line busy)	CB	participant requested call back	WD	withdrew from study
CC	call completed	MV	moved	WN	wrong number
MM	left message on machine	NA	no answer	NT	see notes
MP	left message with person	NE	no English	WR	will return by (time)
PB	participant called back	OT	other (explain)	SC	subject called
CT	Call terminated				

Appendix 7:
Postnatal Sleep and Health Questionnaire

ID:_____

Postnatal Sleep and Health

PLEASE COMPLETE THIS QUESTIONNAIRE WHEN YOUR BABY IS 12 WEEKS OLD

1. What is <u>your</u> date of birth? ..... / ..... / .....
(day) (month) (year)

2. When was your baby born? ..... / ..... / .....
(day) (month) (year)

3. Please write your NHI number here:
(This is your National Health Index number – your midwife or doctor will have this).

4. Which ethnic group do <u>you</u> belong to? *Mark the space or spaces which apply to you.*

- ❍ New Zealand European
- ❍ Māori
- ❍ Samoan
- ❍ Cook Island Māori
- ❍ Tongan
- ❍ Niuean
- ❍ Chinese
- ❍ Indian
- ❍ Other such as DUTCH, JAPANESE, TOKELAUAN. Please state:

.....

5. Which ethnic group does your <u>baby</u> belong to? *Mark the space or spaces which apply to you.*

- ❍ New Zealand European
- ❍ Māori
- ❍ Samoan
- ❍ Cook Island Māori
- ❍ Tongan
- ❍ Niuean
- ❍ Chinese
- ❍ Indian
- ❍ Other such as DUTCH, JAPANESE, TOKELAUAN. Please state:

.....

6. Where do you usually live?

Street number..... Flat Number .....

Street name .....

Suburb or rural locality ..... Post Code .....

City, town or district .....

Telephone number..... Cellphone number.....

7. In the last 12 months what was your <u>households</u> total income, before tax or anything else was taken out of it?

1 ❍ Loss
2 ❍ Zero income
3 ❍ $1 - $5,000
4 ❍ $5,001 - $10,000
5 ❍ $10,001 - $15,000
6 ❍ $15,001 - $20,000
7 ❍ $20,001 - $25,000
8 ❍ $25,001 - $30,000
9 ❍ $30,001 - $35,000
10 ❍ $35,001 - $40,000
11 ❍ $40,001 - $45,000
12 ❍ $45,001 - $50,000
13 ❍ $50,001 - $70,000
14 ❍ $70,001 – $100,000
15 ❍ $100,001 - $150,000
16 ❍ $150,001 or more
17 ❍ don't know

Please go to next page ☞

Paid Work (These questions refer to your work in the **last month**)

8. Do you currently work for pay, profit or income?

1❍ Yes, one paid job 2❍ Yes, more than one paid job

0❍ No *Comments welcome →*

If you answered 'No' please go to question 12, if 'Yes' go to question 9.

9. On average, how many HOURS A WEEK did you work for pay, profit or income? Just think about the LAST MONTH.

Please write how many hours a week here →..... hours a week

10. In the LAST MONTH did you work for pay, profit or income for at least 3 hours between midnight and 5am?

1❍ Yes 0❍ No *(please go to question 12)*

11. In the LAST MONTH what is the total number of nights that you worked for at least 3 hours between midnight and 5am? *Please write how many nights here →*..... nights

12. If you are NOT currently working for pay, profit or income, are you taking paid parental leave?

1❍ Yes 0❍ No

13. Return to work

1❍ I have no plans to return to work

2❍ I plan to return to work but have no date in mind

3❍ I expect to be back at work when my baby is ..... *(write baby's age)*

Please go to next page ☞

Support & dependents

14. How many people normally live in your home?.....

15. How many of these people need looking after by you (not counting you)?

What are their ages? .....

16. Support for you at home

Do you live with anyone you can count on to help you with:

Financial support 1❍Yes 0❍ No

If Yes, who? (e.g. partner, friend, parent) .....

Emotional support (e.g. someone who listens or is 'there' for you) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Advice (e.g. can give information or guidance about baby care and parenting) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Concrete/Practical support (e.g. baby care, housework, cooking) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

17. Support for you – outside of home

Are there other people, not living with you, who you can count on to help with;

Financial support 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Emotional support (e.g. someone who listens or is 'there' for you) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Advice (e.g. can give information or guidance about baby care and parenting) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

Concrete/Practical support (e.g. baby care, housework, cooking) 1❍Yes 0❍ No

If YES, who? (e.g. partner, friend, parent) .....

18. If you have a partner do they currently work for pay, profit or income?

1❍ Yes 0❍ No **OR** 2❍ Not applicable

If "Yes", have they been able to take time off work to be with you and the baby?

1❍ Yes - how much time? .....

0❍ No

Please go to next page ☞

Having a baby can affect how we feel about relationships. We are interested to know how you feel about your relationships with your partner right now. We understand that this may not be how you usually feel. If you do not have a partner please go to Question 20.

19. If you have a partner, how is your relationship with them at the moment?:
Please circle one number

Perfectly Happy — Extremely Unhappy **OR** 8❍ Not applicable

0 1 2 3 4 5 6 7

20. How often is a motor vehicle (not counting motorbikes) available for your use?

	NO DAYS						EVERY DAY
Circle the number of days a week	0	1	2	3	4	5	6	7

Birth

21. How old is your baby now? ……weeks

22. How many weeks pregnant were you when your baby was born? ……weeks

23. At what time was your baby born? ……pm / am (please write the time **and** circle pm or am)

24. What was your baby's birth weight? ……grams or …… pounds/ounces

25. What was your baby's length at birth? ……cm

26. What was <u>your weight</u> when your baby was born?

……kgs **OR** …… stones …… lbs ❍ Don't know

27. If you experienced labour, how long was it for – from the time you started to experience regular contractions? ……hours

28.Where was your baby born? (e.g. at home, or name of maternity unit/hospital)

Is this where you planned to give birth? 1❍ Yes 0❍ No

If 'No', where did you plan to give birth? (e.g. at home, or name of maternity unit/hospital)

Please go to next page ☞

29. How was your baby born? *Tick all that apply*

❍ Induced (you had an "induction")

❍ Vaginally

❍ With the help of forceps or ventouse (vacuum)

❍ A planned caesarean (you were expecting to have a caesarean that day)

❍ An emergency, but pre-planned caesarean (you were expecting to have a caesarean on another day)

❍ An unexpected or emergency caesarean (you weren't expecting to have a caesarean)

30. Overall, how was your experience of labour and birth? *Please circle one number*

0	1	2	3	4	5
Great Better than I thought		Challenging but manageable		Terrible, never again Much worse than I thought	

Comments welcome:

Anaesthesia

31. Did you have an epidural (injection in the back) **during labour?**

0❍ No 1❍ Yes *Comments welcome:*

32. Did you have a general anaesthetic for the birth? *(You were given medicine to make you go to sleep for the birth – sometimes this happens for a caesarean section).*

0❍ No 1❍ Yes *Comments welcome:*

If "Yes" – was this planned: 1❍ No 0❍ Yes

33. Were there any complications during the birth?

0❍ No 1❍ Yes *Comments welcome:*

34. Did you bleed excessively at, or after birth?

0❍ No 1❍ Yes

Please go to next page ☞

35. Did you require a blood transfusion during or after birth?

0❍ No 1❍ Yes

36. If you gave birth in hospital, how long did you stay there after your baby was born?

……hours **OR** ……nights

37. Did your baby have any illness in the first week of life that required assessment by a paediatrician or admission to the neonatal or special care baby unit?

0❍ No 1❍ Yes *Comments welcome:*

38. Was your baby born with any congenital abnormalities that required assessment by a paediatrician or admission to the neonatal or special care baby unit?

0❍ No 1❍ Yes *Comments welcome:*

39. Did you feel you knew enough about what was going on during your birth experience?

0 1 2 3 4 5
Not at all Very much

40.Did you feel listened to during your labour and birth experience?

0 1 2 3 4 5
Not at all Very much

Please go to next page ☞

Feeding your baby

41. How would you describe feeding your baby to start with?

Please circle one number 0 1 2 3 4 5

Easy - no problems

Very difficult - lots of problems

Comments welcome:

42. If feeding was difficult at the start, how long was it difficult for? ..... weeks

43. What was your baby's source of milk in the last 48 hours?

1❍ Baby has received breast milk only, in the last 48 hours

2❍ Baby has received some breast milk and some formula in the last 48 hours

3❍ Baby has received only infant formula in the last 48 hours

4❍ Other, in the last 48 hours – *please describe* →

44. Has your baby only ever received breast milk (no water, formula or other foods)?

1❍ Yes 0❍ No

45. Is this how you hoped to be feeding your baby?

1❍ Yes 0❍ No 2❍ Don't know

Comments welcome:

46. How is feeding going now? *Please circle*

0 1 2 3 4 5

Easy - no problems

Very difficult - lots of problems

Comments welcome:

Please go to next page ☞

47. **Are you the only one who feeds your baby?** 1❍ Yes 0❍ No

If "No", on how many days a week does someone else feed your baby?

Circle the number of days a week

1	2	3	4	5	6	7
Once a week						Daily

48. **How many times has your baby fed in the last 24 hours?**

Please circle one number

1	2	3	4	5	6	7	8	9	10 or more

49. **How many times did you wake up last night to feed your baby?**

Please circle one number

0	1	2	3	4	5 or more

50. **How many times did you wake up for your baby last night for another reason?**

Please circle one number

0	1	2	3	4	5 or more

51. **How often do you have help at night with baby care, if you want it?**

Please circle one number

NO NIGHTS							EVERY NIGHT
0	1	2	3	4	5	6	7

OR I could have help at night but I don't need it 8❍

Sleep – since you have had your baby

52. **How many hours sleep, including naps, do you usually get in 24 hours?**
(just think about the last week)

Please write the number of hours here ..... hours

53. **In the last week, how often did you get a good night's sleep?**

Circle the number of days

NO NIGHTS							EVERY NIGHT
0	1	2	3	4	5	6	7

54. **How long on average, per day, do you spend outside (really outside) exposed to daylight?**

..... hours ..... minutes

Please go to next page ☞

55. On how many nights in the last week did the following things disturb your sleep?

Please circle one number in every row.

	NO NIGHTS							EVERY NIGHT
Going to the bathroom	0	1	2	3	4	5	6	7
Pain in back/neck/joints	0	1	2	3	4	5	6	7
Dreams	0	1	2	3	4	5	6	7
Nightmares	0	1	2	3	4	5	6	7
Heartburn	0	1	2	3	4	5	6	7
Nasal congestion (blocked nose)	0	1	2	3	4	5	6	7
Leg cramps	0	1	2	3	4	5	6	7
Feeling too hot or cold	0	1	2	3	4	5	6	7
Thinking or worrying about things	0	1	2	3	4	5	6	7
Just can't get comfortable	0	1	2	3	4	5	6	7
Just can't get to sleep	0	1	2	3	4	5	6	7
Feeding baby	0	1	2	3	4	5	6	7
Breast leaking or uncomfortable	0	1	2	3	4	5	6	7
Other baby care	0	1	2	3	4	5	6	7
Other children	0	1	2	3	4	5	6	7
Disturbed by partner (e.g. snoring)	0	1	2	3	4	5	6	7
Other	0	1	2	3	4	5	6	7

56. During sleep in the LAST WEEK, has anyone told you that you did any of the following? Please circle how often .

Circle one number in every row	NO NIGHTS							EVERY NIGHT
Loud snoring	0	1	2	3	4	5	6	7
Long pauses between breaths while asleep	0	1	2	3	4	5	6	7
Legs twitching or jerking while you sleep	0	1	2	3	4	5	6	7

57. Do you ever experience an urge to move your legs (usually accompanied by unpleasant sensations)?

1❍ Yes 0❍ No – *if "No" please go to question 59*

58. If you answered "Yes" in Question 57, is this: *Tick all that apply to you*

1❍ worse at night?

2❍ more noticeable when you rest?

3❍ relieved by movement?

Please go to next page ☞

59. How often in the last week did you:

Please circle one number in every row.

	NO NIGHTS							EVERY NIGHT
Have difficulty getting to sleep	0	1	2	3	4	5	6	7
Wake up during your sleep period	0	1	2	3	4	5	6	7
Wake up too early at the end of a sleep period	0	1	2	3	4	5	6	7
Feel rested upon awakening at the end of a sleep period	0	1	2	3	4	5	6	7
Sleep poorly	0	1	2	3	4	5	6	7
Feel sleepy during the day	0	1	2	3	4	5	6	7
Struggle to stay awake during the day	0	1	2	3	4	5	6	7
Feel irritable during the day	0	1	2	3	4	5	6	7
Feel tired or fatigued during the day	0	1	2	3	4	5	6	7
Feel satisfied with the quality of your sleep	0	1	2	3	4	5	6	7
Feel alert and energetic during the day	0	1	2	3	4	5	6	7
Get too much sleep	0	1	2	3	4	5	6	7
Get too little sleep	0	1	2	3	4	5	6	7
Take a nap at a scheduled time	0	1	2	3	4	5	6	7
Fall asleep at an unscheduled time	0	1	2	3	4	5	6	7
Use a prescription sleeping pill to help you get to sleep	0	1	2	3	4	5	6	7
Use any pain medication to help you get to sleep (e.g. Panadol)	0	1	2	3	4	5	6	7
Take anything else to help you sleep	0	1	2	3	4	5	6	7

If so, what did you take to help you sleep:.....

60. How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? *This refers to your usual way of life in recent times.*

PLEASE TICK ONE CIRCLE ON EACH LINE

	would never doze	slight chance	moderate chance	high chance
Sitting and reading	0 ❍	1 ❍	2 ❍	3 ❍
Watching TV	0 ❍	1 ❍	2 ❍	3 ❍
Sitting inactive in a public place (e.g. movies, meeting)	0 ❍	1 ❍	2 ❍	3 ❍
As a passenger in a car for an hour without a break	0 ❍	1 ❍	2 ❍	3 ❍
Lying down in the afternoon when circumstances permit	0 ❍	1 ❍	2 ❍	3 ❍
Sitting and talking to someone	0 ❍	1 ❍	2 ❍	3 ❍
Sitting quietly after a lunch without alcohol	0 ❍	1 ❍	2 ❍	3 ❍
In a car, while stopped for a few minutes in traffic	0 ❍	1 ❍	2 ❍	3 ❍

PLEASE MAKE SURE YOU HAVE TICKED ONE BOX ON EACH LINE

Please go to next page ☞

General health and well-being

61. Are you currently having <u>any treatment or monitoring</u> for any of these conditions?
Please tick one circle on every line.

	Yes	No	Don't know/ can't remember
High blood pressure (hypertension)	1❍	0❍	2❍
Pain as a result of the birth	1❍	0❍	2❍
Breast infection (mastitis)	1❍	0❍	2❍
Low iron or anaemia	1❍	0❍	2❍
Birth related infection	1❍	0❍	2❍
Urinary incontinence	1❍	0❍	2❍
Faecal incontinence	1❍	0❍	2❍

62. Are you currently having <u>any treatment or monitoring</u> for any other conditions such as:
If 'No' please go to question 63

Other medical problem(s) – please specify (e.g. diabetes, severe back problem, another medical condition):

Mental health problem(s) – please specify (e.g. depression or other mental health condition):

Diagnosed sleep disorder – please specify:

63. Please list any medicines you are currently taking.

64. During this most recent pregnancy were you distressed by feelings of anxiety or depression for 2 weeks or more?

1❍ Yes 0❍ No– *go to question 65*

If so, did this distress:

a) Interfere with your ability to get things done or your relationships with family and friends?
Please circle one number

0	1	2	3	4	5
Not at all		somewhat			very much

b) Lead you to seek professional help?

1❍ Yes 0❍ No

Please go to next page ☞

65. In the first week after your baby was born did you experience times of unexplained tears, feeling very up and then very down or feeling like you were on an emotional roller-coaster – sometimes called the "baby blues"?

1❍ Yes 0❍ No– *go to question 66*

If "Yes", how long did these feelings last? *Please circle one number*

0	1	2	3
Less than than a day	One to two days	Three days to a week	More than a week

Life events

66. This question is about things that may have happened <u>during the last 12 months</u>.
Tick all that apply to you - if none of these apply please go to question 67

❍ A close family member was very sick and had to go into hospital
❍ I broke up with, got separated or divorced from my partner
❍ I moved to a new address
❍ I was homeless
❍ My partner lost their job
❍ I lost my job even though I wanted to go on working
❍ I argued with my partner more than usual
❍ My partner said they did not want me to be pregnant
❍ I had a lot of bills I couldn't pay
❍ I was in a physical fight
❍ My partner or I went to jail
❍ Someone very close to me had a bad problem with drinking or drugs
❍ Someone very close to me died

Feelings since you have had your baby

67. Please tick the answer which comes closest to how you have felt <u>IN THE LAST 7 DAYS</u>, not just how you feel today.

I have been able to laugh and see the funny side of things.
0❍ As much as I always could
1❍ Not quite so much now
2❍ Definitely not so much now
3❍ Not at all

I have looked forward with enjoyment to things.
0❍ As much as I ever did
1❍ Rather less than I used to
2❍ Definitely less than I used to
3❍ Hardly at all

Please go to next page ☞

I have blamed myself unnecessarily when things went wrong.

3❍Yes, most of the time
2❍Yes, some of the time
1❍Not very often
0❍No, never

I have been anxious or worried for no good reason.

0❍No, not at all
1❍Hardly ever
2❍Yes, sometimes
3❍Yes, very often

I have felt scared or panicky for no very good reason.

3❍Yes, quite a lot
2❍Yes, sometimes
1❍No, not much
0❍No, not at all

Things have been getting on top of me.

3❍Yes, most of the time I haven't been able to cope at all
2❍Yes, sometimes I haven't been coping as well as usual
1❍No, most of the time I have coped quite well
0❍No, I have been coping as well as ever

I have been so unhappy that I have had difficulty sleeping.

3❍Yes, most of the time
2❍Yes, sometimes
1❍Not very often
0❍No, not at all

I have felt sad or miserable.

3❍Yes, most of the time
2❍Yes, quite often
1❍Not very often
0❍No, not at all

I have been so unhappy that I have been crying.

3❍Yes, most of the time
2❍Yes, quite often
1❍Only occasionally
0❍No, never

The thought of harming myself has occurred to me.

3❍Yes, quite often
2❍Sometimes
1❍Hardly ever
0❍Never

Please go to next page ☞

68. The following are statements about worrying. Please read each statement and indicate how true each one is in describing your general/usual experience of worrying.
Please tick the one option that most likely applies to you for each statement

When I worry, it interferes with my day-to-day functioning (e.g. stops me getting my work done, organising myself or my activities).

0❍ Not true at all 1❍ Somewhat true 2❍ Moderately true 3❍ Definitely true

When I think I should be finished worrying about something, I find myself worrying about the same thing, over and over.

0❍ Not true at all 1❍ Somewhat true 2❍ Moderately true 3❍ Definitely true

My worrying leads me to feel down and depressed.

0❍ Not true at all 1❍ Somewhat true 2❍ Moderately true 3❍ Definitely true

When I worry, it interferes with my ability to make decisions or solve problems.

0❍ Not true at all 1❍ Somewhat true 2❍ Moderately true 3❍ Definitely true

I feel tense and anxious when I worry.

0❍ Not true at all 1❍ Somewhat true 2❍ Moderately true 3❍ Definitely true

I worry that bad things or events are certain to happen.

0❍ Not true at all 1❍ Somewhat true 2❍ Moderately true 3❍ Definitely true

I often worry about not being able to stop myself from worrying.

0❍ Not true at all 1❍ Somewhat true 2❍ Moderately true 3❍ Definitely true

As a consequence of my worrying, I tend to feel emotional unease or discomfort.

0❍ Not true at all 1❍ Somewhat true 2❍ Moderately true 3❍ Definitely true

Please go to next page ☞

Your baby

69. In general how often does your baby cry?

0	1	2	3	4	5
Never					Very often

70. When your baby has been upset and you do things to try and calm him/her down (like rocking, walking, showing toys), how often does he/she take more than 10 minutes to calm down?

Please circle one number

Never	Very rarely	Less than half the time	About half the time	More than half the time	Almost always	Always
1	2	3	4	5	6	7

71. When being held, how often does your baby:

Pull away or kick?

Please circle one number

Never	Very rarely	Less than half the time	About half the time	More than half the time	Almost always	Always
1	2	3	4	5	6	7

Seem to enjoy him/herself?

Please circle one number

Never	Very rarely	Less than half the time	About half the time	More than half the time	Almost always	Always
1	2	3	4	5	6	7

72. When going to bed, how often does your baby settle within 10 minutes?

Please circle one number

Never	Very rarely	Less than half the time	About half the time	More than half the time	Almost always	Always
1	2	3	4	5	6	7

73. When your baby is upset about something, how often does s/he stay upset for 20 minutes or longer?

Please circle one number

Never	Very rarely	Less than half the time	About half the time	More than half the time	Almost always	Always
1	2	3	4	5	6	7

Please go to next page ☞

Baby's health

74. Which of the following has your baby had during the LAST WEEK?
Tick all that apply (or go to question 75 if none apply)

- ❍ Fever (high temperature)
- ❍ Diarrhoea
- ❍ Vomiting
- ❍ Ear infection
- ❍ Colic
- ❍ Fussy or irritable
- ❍ Reflux
- ❍ Runny nose or cold
- ❍ Cough or wheeze
- ❍ Chest infection
- ❍ Asthma
- ❍ Food allergy
- ❍ Eczema (atopic dermatitis)
- ❍ None of these

75. Did your baby receive any of the following medicines in the last 2 weeks?
(Please do not include vitamins or minerals).

Antibiotics 1❍ Yes 0❍ No

Other prescription medicine 1❍ Yes 0❍ No
If "Yes" please write the name of the medicine(s) here:

Non-prescription medicine 1❍ Yes 0❍ No
If "Yes" please write the name of the medicine(s) here:

76. Has your baby received immunisation injections in the last 48-hours?

1❍ Yes 0❍ No

Baby's sleep in the last week

77. Where does your baby sleep *most* of the time during the DAY?

- In his/her own room 1❍
- In parents' room 2❍
- In sibling or other's room 3❍
- In another room of the house 4❍
- With you or another person e.g. being held or in a sling 5❍
- Moving around with you e.g. in a pram or basket 6❍
- Other – please state where: 7❍

Please go to next page ☞

78. Where does your baby sleep *most* of the time at NIGHT?

In his/her own room	1 ❍
In parents' room	2 ❍
In sibling or other's room	3 ❍
In another room of the house	4 ❍
Other – please state where:	5 ❍

79. What does your baby sleep in *most* of the time during the DAY?

Bassinet	1 ❍
Cot	2 ❍
Parents' bed	3 ❍
Infant seat	4 ❍
Being held or in a sling/front pack	5 ❍
In a pram or buggy	6 ❍
Other – please state what:	7 ❍

80. What does your baby sleep in *most* of the time at NIGHT?

Bassinet	1 ❍
Cot	2 ❍
Parents' bed	3 ❍
Infant seat	4 ❍
In a pram or buggy	5 ❍
Other – please state what:	6 ❍

81. In the last week did your baby start their night sleep in one location, and then move to another location during the night?

(For example, baby went to sleep in own cot, then moved to your bed and went to sleep again)**.**

1 ❍ Yes 0 ❍ No – *go to question 83*

If "Yes", on how many nights did they change their sleep location?

Circle the number of nights 1 2 3 4 5 6 7

Please go to next page ☞

82. If you answered "Yes" to question 81, why did your baby move sleep location during the night?
(Feel free to list more than one reason).

83. How often does your baby go off to sleep with help from others?
(e.g. being fed, rocked or cuddled)

Circle one number	0	1	2	3
	Never	Rarely	Often	Always

84. In general do you consider your child's sleep as a problem?

2 ❍ A very serious problem

1 ❍ A small problem

0 ❍ Not a problem at all

85. How many times does your baby usually wake up between 10pm and 6am?

0	1	2	3	4 or more
Not at all				times

86. What is the longest stretch of time that your baby is asleep during the night without waking up?

0	1	2	3	4	5
Less than 30 minutes	30 mins to 1 hour	1 to 2 hours	2 to 3 hours	3 to 4 hours	More than than 4 hour

87. What is the *longest* stretch of time that your baby usually sleeps during the day?

0	1	2	3	4	5
Less than 30 minutes	30 mins to 1 hour	1 to 2 hours	2 to 3 hours	3 to 4 hours	More than than 4 hour

88. How often do your baby's sleep patterns allow you to get a reasonable, total amount of sleep in 24 hours?

	NO DAYS						EVERY DAY
Circle the number of days	0	1	2	3	4	5	6	7

Please go to next page ☞

89. How often do your baby's daytime sleep patterns allow you to have a break?

	NO DAYS						EVERY DAY
Circle the number of days	0	1	2	3	4	5	6	7

90. How much do your baby's sleep patterns change from day to day?

0	1	2	3
Always the same	Change occasionally	Change often	Everyday is different

91. Date questionnaire completed ..... / ..... / .....
(day) (month) (year)

Please take a moment now to flick through every page of this survey and check that you have answered all the questions you meant to.

A $20 voucher, from the choice of three options, below will be posted to you when we receive this completed questionnaire. Please ensure you advise us if your address has changed.

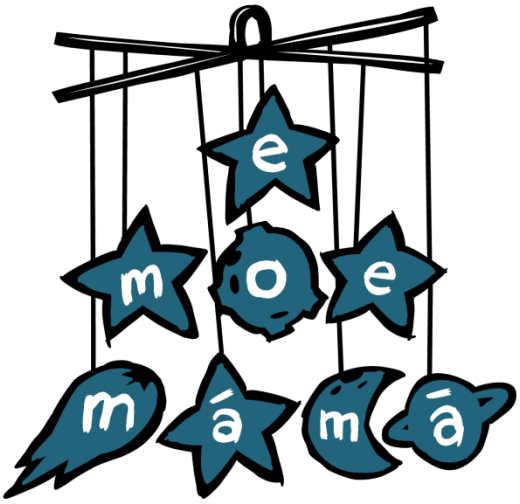
Please indicate the type of voucher you would prefer (tick one):

Petrol ☐ (MTA) Supermarket ☐ (New World) Department store ☐ (Farmers)

Important note

If you feel concerned about *any* of the issues raised by completing this questionnaire, we suggest that you discuss these with your Lead Maternity Carer, doctor or other health professional.

The end. Thank you.



E Moe, Māmā, Maternal Sleep and Health in Aotearoa/New Zealand

For more information contact: mumsleep@massey.ac.nz **or visit** http://sleepwake.massey.ac.nz/ **or freephone** 0800MUMSLEEP (0800 686 7537) **or free text** SLEEP to 5222.

Return to: Sleep/Wake Research Centre, Massey University, PO Box 756, Wellington 6140

Appendix 8:
PIPIS Study information pack contents

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Dear Madam,

21 July 2010

PIPIS PROJECT

Sleep in new mothers and their babies in Aotearoa/New Zealand

Sleep is very important for our health. The Sleep/Wake Research Centre is a multi-disciplinary research team who are committed to improving the health, performance, safety, and well-being of New Zealanders through a better understanding of links between sleep and waking function. The PIPIS project is a pilot study and will form part of a PhD thesis for Ms. Bronwyn Sweeney. Other members of the research team involved in this study from the Sleep/Wake Research Centre are Dr. Leigh Signal (Senior Research Officer and Principal Investigator), Dr. Sarah-Jane Paine (Tūhoe, Post-Doctoral Research Fellow), and Professor Philippa Gander (Director). We are also working with Professor Kathy Lee from the University of California and Dr. Mark Huthwaite (Senior Lecturer and Psychiatrist) from the University of Otago, Wellington.

You are invited to take part in a pilot study investigating sleep and health in pregnant and postpartum women and their babies. Thirty women will be invited to participate in this study, and information collected from those women may be added to information also being collected from 1,000 women participating in a separate, large scale study. The large scale study uses questionnaires only to gather information; this study will use questionnaires and measure the sleep of both mothers and babies using activity monitors.
We are currently trying to find out:

1. How much sleep new mothers and their babies get at 6 weeks and 12 weeks after birth.
2. If there is a relationship between sleep duration and quality during late pregnancy and early postpartum and changes in postpartum mood.
3. What information might be helpful for new parents at this time.
4. How effective the methods and processes used in this study are.

In this study pack you will find an information sheet that explains the study in more detail. If you choose to participate in the study after reading the information sheet, please complete the consent form and two questionnaires. Please use the self-addressed envelope provided, and return the consent form and questionnaires to the research team.

If you have any concerns or questions about the study please contact Bronwyn Sweeney directly – her details are shown on the side of this letter. You may also contact any member of the research team if you choose, or simply email mumsleep@massey.ac.nz.

Thank you for your consideration of this study.
Sincerely,

Encl (Consent form, Information sheet, 2 x Questionnaires, Post-paid return envelope)

MASSEY UNIVERSITY

CONSENT FORM

PIPIS PROJECT

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

- I have read and I understand the information sheet dated 21 July 2010 for volunteers taking part in the study designed to investigate sleep and health in mothers and infants. I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.
- I have had the opportunity to use whānau support or a friend to help me ask questions and understand the study.
- I understand that taking part in this study is voluntary (my choice), and that I may withdraw from the study at any time and this will in no way affect my health care.
- I understand that some participants in the study will be randomly allocated by the research team to receive additional sleep related information in pregnancy and that I may or may not be assigned to this group. I also understand that after my baby has reached 12-weeks of age I will receive all sleep related information available in the study.
- I understand that participation in this study is confidential and that no material that could identify me will be used in any reports on this study.
- I have had time to consider whether to take part in the study.
- I know whom to contact if I have any questions about the study.
- I wish to receive a copy of the results. YES ◯ NO ◯

  Please be aware that there will be a delay between data collection and the publication of the results. This study will take 3 years to complete and the results will be available in mid 2012.
- I consent to information related to the birth of my baby being made available by the maternity service where I give birth. YES ◯ NO ◯
- If any of the questionnaires suggest that I am at elevated risk for postnatal depression I consent to this information being sent to my Lead Maternity Carer, doctor or other health professional. YES
  YES ◯ NO ◯

  If YES please provide Lead Maternity Carer/doctor's name and location: _____

  _____
- If any of the questionnaires suggest that my baby may have a sleep related problem, I consent to this information being reviewed by an appropriate health professional. YES ◯ NO ◯

PLEASE TURN OVER AND CONTINUE READING THIS FORM BEFORE SIGNING

Sleep/Wake Research Centre
Moe Tika, Moe Pai

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PO Box 756
Wellington 6140
New Zealand

Administration
+64 (0)4 380 0603

Study enquiry line
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Department of Psychological Medicine
University of Otago, Wellington
Direct Telephone
+64 (0)4 385 5541
Email
Mark.Huthwaite@otago.ac.nz

I (full name) _____

hereby consent to take part in this study.

Signature _____

Date _____

IMPORTANT: So that we can contact you about the next stage of the study, please complete the following:

Address: _____ Date baby is due: _____

_____ Phone (home): _____

_____ Cell phone: _____

_____ Postcode: _____

Email: _____

(Preferably not a work email unless you will be accessing those emails after your baby is born).

A photocopy of the completed consent form will be returned to you.

MASSEY UNIVERSITY

21 July 2010

Sleep/Wake
Research Centre
Moe Tika, Moe Pai

**Massey University –
Wellington Campus**
PO Box 756
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New Zealand

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INFORMATION SHEET
PIPIS PROJECT

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

You are invited to take part in a pilot study investigating sleep and health in pregnant and postpartum women and their babies.

Your participation is entirely voluntary (your choice). You do not have to take part in this study and if you choose not to take part this will in no way affect your current or future care or treatment.

If you do agree to take part in the study, you are free to withdraw from the study at any time, without having to give a reason, and this will in no way affect your current or future care or treatment.

About the study

The aims of the study are to:

- Objectively measure the amount of sleep new mothers and their babies obtain at 6 weeks and
- Investigate if there is a relationship between sleep duration and quality during late pregnancy a changes in postpartum mood.
- Explore what information might be helpful for new parents at this time.
- Trial methods and processes in anticipation of future studies with these aims.

Participants

Thirty women will be invited to participate in this study by their childbirth educator or a member of the research team through an antenatal class.

<u>To be included you must:</u>

- Be 16 years of age or over.
- Be having your first baby, which is a singleton (not twins or multiples).
- Be able to complete the study questionnaires in English.
- Have a telephone (which can be a cell phone or landline).
- Plan to provide full-time care to your baby for at least the first 12 weeks after birth.

<u>You will not be eligible for this study if:</u>

- You, or your partner (if you have one), have experienced a stillbirth or perinatal death at greater than or equal to 20 weeks gestational age. (Women with previous miscarriages at less than 20 weeks gestation are eligible).
- Your partner has children from another relationship.
- You have a chronic illness that is not being well controlled at the moment (e.g. diabetes, asthma).
- You use prescription medications that affect sleep (e.g. benzodiazepines).
- You, or your partner, have a diagnosed sleep disorder.
- You are involved in another research study involving sleep.

Location and timing of the study
Your involvement in the study will begin in late pregnancy (between 35-37 weeks). All study questionnaires can be answered by you in your own time and in your own home. In late pregnancy you will participate in a one-off information session about the study. Your participation will span a 4 month period. The entire study will run for 3 years and be finished in the middle of 2012.

Participants from the same childbirth education class will be grouped together. Some groups will be assigned to receive general sleep information, complete survey questionnaires, and have their sleep and their baby's sleep monitored on two occasions (study option A). Other groups will complete these aspects of the study, and receive additional sleep related information (study option B). Groups will be randomly allocated to either study option A or B by the research team. You cannot choose which study option you are assigned to however, once the 12-week postpartum surveys and sleep monitoring is complete all women will receive all sleep related information available in the study.

What is involved if you decide to participate?

- You will talk to a member of the research team and answer questions to make sure you are eligible to participate in this study. There is no obligation for you to be in this, or any study, after talking to a research team member.
- You will complete a consent form which applies to your participation and your baby's participation.
- You will complete and return two questionnaires in weeks 35-37 of your pregnancy. The questionnaires take a total of approximately 35-45 minutes to complete.
- You will attend a group meeting in late pregnancy, to give you some information about sleep, and explain how we will measure your sleep and your baby's sleep. Depending on which study option group you are assigned to, the information session will take between 1 to 2¼ hours.
- During the first six weeks after your baby is born you will be contacted on at least two occasions by a member of the research team to ask questions about your current sleep and mood, and to make arrangements for delivery of the Actiwatches and sleep diaries.
- When your baby is 6 weeks old you will complete one questionnaire. This questionnaire takes approximately 15-20 minutes to complete. You will also complete diary forms about your sleep and your baby's sleep during a 48-hour period (each diary entry takes no more than 2 minutes). You and your baby will each wear a small activity monitor called an Actiwatch for 48-hours – see the "Benefits and risks" section for more information about the Actiwatch.
- When your baby is 12 weeks old complete and return two final questionnaires. These questionnaires take a total of approximately 35-45 minutes to complete. You and you baby will wear Actiwatches again for 48-hours and you will complete diary forms for the same 48-hours.
- If you have given us permission, we will access information from the maternity service where you gave birth to obtain information such as the duration of your labour, type of birth (e.g. spontaneous vaginal, forceps, etc), and birth weight of your baby.

The information you provide in the Consent Form may be used to contact you via text, email or telephone, to remind you about questionnaire completion.

Benefits and risks
Sleep Monitoring: An Actiwatch is a small watch-like device which continuously monitors movement from which we can identify periods of sleep and activity. Adults wear the Actiwatch just like a watch on the wrist, and babies wear the watch in a soft, cotton band around the leg. Please be aware that the Actiwatch does not monitor your baby's breathing; it is not a tool to provide additional safety or monitoring of your child's sleep and it is not fitted with any alarms. We ask that you and your baby both wear an Actiwatch at all times during the 48-hour period of monitoring except when bathing. The Actiwatch is a widely used tool in sleep research and it is non-invasive. Each infant participant will be given a single-use band for each 48-hour period of monitoring. The Actiwatch itself will be sterilised between participants. You will not be held liable if the Actiwatch is damaged or lost.

Other: If you choose to be in this study you will have an opportunity to learn about sleep and the changes to sleep that occur immediately before and after the birth of your child. You will also have the option to receive an annotated print out of your sleep and your baby's sleep/wake patterns as recorded by the Actiwatch and the sleep diary, and have the opportunity to discuss it. In addition, once the study is complete, all participating families will receive a short brochure describing the study findings.

You will be provided with a $20 voucher from a choice of three options (petrol, supermarket or department store) when you return completed questionnaires in late pregnancy, and at 6 and 12 weeks postpartum. You will also be provided with a $50 voucher from a choice of the same three options if you are required to travel to an information session, to reimburse you for your travel to the session venue.

General

Will my GP and/or Lead Maternity Carer be told I am in the study?

Included in one questionnaire at each time-point is a scale to screen for postnatal depression. If the results of the scale suggest you may be at risk from this disorder then we will tell you. We will then suggest where you can go for further evaluation and treatment. If you choose, we will also notify your Lead Maternity Carer, GP or other health care provider. Two of the questionnaires contain questions about the sleep of your baby. If the results of these questions suggest that your baby may have a sleep related problem, and if you choose, we will have this information reviewed by an appropriate health professional, who will advise what to do next.

Where can I get more information about the study?

You can contact a member of the research team using their details provided on this information sheet, or email them at mumsleep@massey.ac.nz, or phone them on 0800 MUMSLEEP (0800 686 7537).

If I need an interpreter, can one be provided?

No. Study documents and questionnaires will be provided in English only. It is a study requirement that you are able to complete the questions in English.

You may have a friend, family or whānau support to help you understand the risks and/or benefits of this study and any other explanation you may require.

You do not have to answer all the questions in the questionnaires or the phone calls, and you may stop a phone call at any time.

If you have any queries or concerns regarding your rights as a participant in this study, you may wish to contact an independent health and disability advocate:

Free phone: 0800 555 050

Free fax: 0800 2 SUPPORT (0800 2787 7678)

Email: advocacy@hdc.org.nz

Confidentiality

- No material that could personally identify you will be used in any reports on the study.
- Questionnaires will not have your name on them. Instead they will have a code number and all data will be stored in a secure cabinet at Massey University's Sleep/Wake Research Centre.
- On completion of the project data will be archived securely for ten years.

Results

The data will be analysed and included as part of a PhD thesis. You will have the option to receive an annotated printout of your own, and your baby's, sleep/wake patterns as recorded by the Actiwatch and the sleep diary, and have the opportunity to discuss it. In addition, all participating families will receive a summary of the findings of the study and have access to a copy of any publications. Please be aware that there will be a delay between data collection and the publication of the results. This study will take 3 years to complete and the results will be available in mid 2012.

Ethics

This study has received ethical approval from the Central Health and Disability Ethics Committee, ethics reference number (approval number: CEN/09/09/070).

What do I do now?

If you choose to participate in the study after reading this information sheet, please complete the attached consent form and two questionnaires. Please use the self-addressed envelope provided and return the consent form and questionnaires to the research team.

Thank you for taking the time to consider being involved in the study. Any of the members of the research team would be happy to answer questions you may have about this study, or you can email them at mumsleep@massey.ac.nz, or phone them on 0800 MUMSLEEP (0800 686 7537).

Appendix 9: Safe sleep essentials pamphlet

Safe Sleep Check

Young babies nap and sleep in many places. This safety check is a way to be confident that every sleep is as safe as possible for your baby.

1. From the very start, make your baby as strong as possible (less vulnerable)

- ☐ Smokefree in pregnancy?
- ☐ Born after 36 weeks?
- ☐ Weighed more than 2500 gm at birth?
- ☐ Breastfed?

Essential: More vulnerable babies need the extra protection of their very own 'baby bed' (a bed designed for babies) every time they sleep.

2. For every sleep, make it as easy as possible for your baby to breathe

- ☐ Placed for sleep face up (on the back)?
- ☐ Plenty of space around your baby's face?
- ☐ In a safe space (no chance of getting onto the tummy, under covers, near pillows or into gaps)?
- ☐ Breathes only smokefree air?

3. In every place your baby sleeps, make it as safe as possible

- ☐ Close by you (same room as you when you sleep)?
- ☐ In own 'baby bed' or own safe space?
- ☐ All possible hazards noticed and removed or avoided?
- ☐ A sober person with your baby if there is alcohol, drugs or partying?

atawhaitia ahau i roto moemoea

from my earliest beginnings, pursue protection so that I may dream

Tummy time

Back for sleep, front for play, upright for cuddles and hugs.

This will help **gravity** protect your baby's head shape.

Summary

Sleeping **face up** (on the back) protects babies through a critical stage of development.

A **clear face** protects babies from suffocation.

A **smokefree** start to life makes babies strong.

The SUDI evidence

Information about SUDI changes as more deaths are explained. Some findings from research are stronger than others. This leaflet is based on major findings agreed by researchers around the world, and is supported by the findings of coroners.

Main Reference:
Carpenter, R.G. et al. Lancet 2004;363:185-91.

October 2009. Code **HE1228**

Child and Youth Mortality Review Committee

The Office of the Chief Coroner

New Zealand Government

www.changeforourchildren.co.nz

safe sleep ESSENTIALS

Every year, about 60 babies die suddenly in their sleep.

Most deaths are preventable.

Safe sleep means
face up, face clear, smokefree
every time and place a baby sleeps.

change FOR OUR children

Information on preventing SUDI (sudden unexpected death in infancy)

Message to parents

Precious new baby? Advice from everyone? How do you decide what is essential and what is not? This leaflet offers you essential up-to-date information to help you keep your baby safe every time and every place they sleep.

What is SUDI?

SUDI stands for sudden, unexpected death in infancy. Some SUDI deaths can be explained (e.g. asphyxia or suffocation). Others cannot be (e.g. SIDS or cot death). Most happen in the first six months of life when a baby is asleep.

How does it happen?

Babies have a natural drive to breathe. This fails for SUDI babies. They stop breathing in their sleep. Their breathing may stop because of:

- things in their sleeping environment
- things that weaken a baby's drive to breathe.

Who is at risk?

SUDI risk comes from a set of things that act together:

- Some babies have a weaker drive to breathe than others, e.g. due to smoking in pregnancy, a low birth weight, being born prematurely or being bottle fed or unwell.
- Some sleeping situations have more hazards than others, e.g. from pillows, unsafe positioning, people in the bed, loose covers, soft bedding or unsafe swaddling.

All babies, all places, every sleep

All babies need protecting from SUDI, in all the places they may sleep, and every time they sleep.

safe sleep = face up + face clear + smokefree

Sudden unexpected death is extremely rare for babies protected by this safety formula.

Face up

Your baby was designed to sleep face up (on the back). Their drive to breathe works best in this position and their airway is also safer. A built-in alarm reminds them to breathe, and strong gag and swallow reflexes protect their airway if they spill.

Face clear

Your baby was designed to sleep with a clear face. This helps them breathe freely and not get too hot. Your baby may fall asleep with their face clear, but will it stay clear? This will depend on how they lie, where they sleep, and how you make it safe.

Smokefree

Your baby was designed to grow and develop smokefree. All smoking harms babies, especially in pregnancy. Smoking takes oxygen and weakens vital systems as babies develop, e.g. breathing. When born, such babies need extra protection.

Other ways to protect your baby from SUDI

Your baby was also designed to need you **close by** (in the same room as you when you sleep), to be **breastfed** (this strengthens their drive to breathe), and to be **handled gently** (to protect their brain). This is essential care for all babies.

Focus on the face

Sleeping babies need to breathe. Placing babies in unsafe sleeping positions, especially if also propped on pillows, swaddled or wrapped, is dangerous. They may suffocate.

What can happen

Too many SUDI babies were placed for sleep on the tummy, or on the side (but rolled forward) or on the back (but propped on pillows). Sadly, many were then found pressed into pillows, underneath bedding, wedged into gaps, with covers over their heads and faces, or under people.

Appendix 10: Child sickness, danger signals pamphlet

CHILD SICKNESS

Danger Signals

Get help quickly from a doctor if your baby or young child shows any of the signs listed below. Learn CPR to be prepared for emergencies.

General

- Cannot be woken or is responding less than usual to what is going on around.
- Has glazed eyes and is not focusing on anything.
- Seems more floppy, drowsy or less alert than usual.
- Has a convulsion or fit.
- Has an unusual cry for one hour or more.
- Has been badly injured.
- There is a bulge in the groin which gets bigger with crying.

Temperature

- Feels too cold or hot (temperature is 38.3°C or higher).

Circulation and skin colour

- Body is much paler than usual or suddenly goes very white.
- Nails are blue, or big toe is completely white, or colour does not return to the toe within three seconds of a squeeze.
- Has a rash of large red or blue spots or bruising.
- Goes blue around the mouth.

Breathing

- Goes blue around the mouth or stops breathing.
- Breathes more quickly than normal or grunts when breathing out.
- Wheezes when breathing out.
- There is visible indrawing of the chest with each breath.

Vomiting and diarrhoea

- Has vomited at least half the feed after each of the last three feeds.
- Has green vomit.
- Has vomiting and diarrhoea together.
- Has drunk less fluid than usual.
- Has passed less urine than usual (fewer wet nappies).
- Has more than a tiny spot of blood in the nappy.

MEDIC ALERT Allergies/Reactions: (record here)

EMERGENCY NUMBERS: National Poisons Centre 0800 764 766
Police/Fire/Ambulance 111

New Zealand Government

MINISTRY OF HEALTH
MANATŪ HAUORA

Ministry of Health, Manatū Hauora, New Zealand. Revised June 2008. Reprinted June 2009. Code **HE7012**

PIPIS weekly telephone support call

Participant ID: __ __ __ __ Infant DOB: ____/____/____

Date this survey **completed:** ____/____/____ Week number: _____

Time survey was **completed:** _____

How are things going in general?	
How is feeding going?	
How much sleep did you get last night?	
How is sleep going?	
What have you tried?	
What has/hasn't worked?	
Suggestions given Sleep signs? In bed awake but drowsy? Relaxation practise?	
Any other concerns or questions about the study?	

PIPIS weekly support call log

Participant ID: __ __ __ __

Name: .....

Home Phone: .....

Cell Phone: .....

Notes: .....

.....

.....

CALLING RECORD

Date	Time	# Called	Code	Notes	Staff

CODES:

BU	busy (phone line busy)	CB	participant requested call back	WD	withdrew from study
CC	call completed	MV	moved	WN	wrong number
MM	left message on machine	NA	no answer	NT	see notes
MP	left message with person	NE	no English	WR	will return by (time)
PB	participant called back	OT	other (explain)	SC	subject called
CT	Call terminated				

Appendix 12: PIPIS control group sleep hygiene pamphlet

E Moe, Mama
Maternal Sleep and Health in Aotearoa/New Zealand Study

Having Trouble Sleeping?

You're not alone. Approximately one quarter of New Zealand adults report having a sleeping problem lasting 6 months or longer. The following recommendations may help you to develop some good sleep habits.

Tips and Hints for Promoting Good Sleep:

- Try to maintain a regular sleep/wake pattern 7 days a week.
- Avoid alcohol, coffee, tea, energy drinks and cigarettes too close to bedtime.
- Regular exercise during the day can promote good sleep at night. However try to avoid exercising too close to bedtime.
- Eating a large meal or spicy food just before bedtime can disrupt your sleep. Don't forget, chocolate contains caffeine!
- Try to get out into natural sunlight during the day. This helps to maintain a healthy sleep/wake cycle.
- Have a relaxing pre-sleep routine, this will help your mind and body relax to fall asleep.
- Keep the bedroom a "safe sleep" zone by doing the following:
  - avoid bringing work or stress to bed as this will only make relaxing before sleep harder
  - keep the room dark, use heavy curtains or wear a sleep mask
  - turn off your phone, use ear plugs if you need to block out noise
  - avoid watching TV, reading or listening to the radio in bed
  - make your bed as comfortable as possible
  - check your room temperature, being too hot or too cold can disturb sleep.

SLEEP-WAKE research centre
MOETIKA-MOE PAI

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

PIPIS – Control group maintenance 1 (2 weeks postpartum)

Participant ID: _____ ___ ___ Infant DOB: _____ /_____/_____

Date this survey **completed**: _____/ _____/_____

Time survey was **completed:** _____

Three questions about **your** sleep in the last 24 hours:	
1. In the last 24 hours, how many 'sleep periods' have you had – so what that means is, in the last 24 hours, how many times have you gone to sleep – including naps. "	
2. So in total, how much sleep have you had in the last 24 hours?	
3. Quality of sleep: how would you rate the quality of your sleep in the last 24 hours? Note comments here:	0- very good 1- good 2- poor 3- very poor

That's all we need to know for now. Thanks for your time. We will call you again when your baby is four weeks old with similar questions.

PIPIS – Contact Log

Control group maintenance 1 (2 weeks postpartum)

Participant ID: _____ ___ ___

Name:.....

Home Phone:.....

Cell Phone:.....

Notes:.....

.....

.....

Intro self.

"You are enrolled in our PIPIS study of sleep changes in pregnancy and after birth. This is the first of two follow up calls we will make before we visit you to measure your sleep and your baby's sleep. Do you have 2-3 minutes now to answer a few short questions?

CALLING RECORD

Date	Time	# Called	Code	Notes	Staff

CODES:

BU	busy (phone line busy)	CB	participant requested call back	WD	withdrew from study
CC	call completed	MV	moved	WN	wrong number
MM	left message on machine	NA	no answer	NT	see notes
MP	left message with person	NE	no English	WR	will return by (time)
PB	participant called back	OT	other (explain)	SC	subject called
CT	Call terminate				

PIPIS – Control group maintenance 2 (4 weeks postpartum)

Participant ID: _____ ___ ___ Infant DOB: _____ / _____/_____

Date this survey **completed**: _____/ _____/_____

Time survey was **completed:** _____

Three questions about **your** sleep in the last 24 hours:	
1. In the last 24 hours, how many 'sleep periods' have you had – so what that means is, in the last 24 hours, how many times have you gone to sleep – including naps. "	
2. So in total, how much sleep have you had in the last 24 hours?	
3. Quality of sleep: how would you rate the quality of your sleep in the last 24 hours? Note comments here:	0- very good 1- good 2- poor 3- very poor

That's all we need to know for now. Thanks for your time. Bronwyn Sweeney will contact you in a week or so to talk about coming to visit to set up the sleep measuring watches.

PIPIS – Contact Log

Control group maintenance 2 (4 weeks postpartum)

Participant ID: _____ ___ ___

Name:.....

Home Phone:.....

Cell Phone:.....

Notes: .....

.....

.....

Intro self.

"You are enrolled in our PIPIS study of sleep changes in pregnancy and after birth. This is the second of two follow up calls we will make before we visit you to measure your sleep and your baby's sleep. Do you have 2-3 minutes now to answer a few short questions?

CALLING RECORD

Date	Time	# Called	Code	Notes	Staff

CODES:

BU	busy (phone line busy)	CB	participant requested call back	WD	withdrew from study
CC	call completed	MV	moved	WN	wrong number
MM	left message on machine	NA	no answer	NT	see notes
MP	left message with person	NE	no English	WR	will return by (time)
PB	participant called back	OT	other (explain)	SC	subject called
CT	Call terminated				

PIPIS Project

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

Pregnancy Questionnaire

1. What is your estimated date of birth (EDD)? _____/_____/_____
   Day Month Year

2. How are you hoping to feed your baby in the first six weeks? (for example, *breastfeed myself, breastfeed myself and expressed breastmilk in cup/bottle, infant formula only, formula and breastmilk etc.*).

3. Have you and your partner discussed these plans for feeding your baby?

   Yes ❍ No ❍ Not applicable ❍

4. How supportive is your partner of these plans for feeding your baby?
   Please circle one number

   0 1 2 3 4 5 OR Not applicable ❍
   Not at all somewhat completely

   Comments:

5. Where are you planning for your baby to sleep *most* of the time at **night**?

   I haven't decided yet ❍
   Own cot or bed in my room ❍
   Own cot or bed in their own room ❍
   Own cot or bed in another room with others ❍
   In my bed ❍
   In my bed, but in a carrier, basket or wahakura ❍
   Other – please state where: ❍ _____

6. Where are you planning for your baby to sleep *most* of the time during the **day**?

   I haven't decided yet ❍
   Own cot or bed in my room ❍
   Own cot or bed in another room ❍
   In my bed ❍
   With me or another person e.g. in a sling ❍
   Moving around with me e.g. in a pram or basket ❍
   Other – please state where: ❍ _____

7. Have you and your partner discussed these plans for your baby's sleeping arrangements?

   Yes ❍ No ❍ Not applicable ❍

8. How much do you and your partner agree on these plans for your baby's sleeping arrangements?
   Please circle one number

   0 1 2 3 4 5 OR Not applicable ❍
   Not at all somewhat completely

   Comments:

9. How many people in your household (not counting you) come and go for work during the evening or night time (7pm to 7am)? ☐

   On average, how many nights per week does this occur? (in total, including all people) ☐

10. Do you or any member of the household have a health condition which may affect the sleep of your baby? (for example a sleep disorder, chronic illness or mental health issue).

    Yes ❍ No ❍

    Comments:

PĪPĪS Project

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

6-weeks Questionnaire

1. Today's date _____/_____/_____
   Day Month Year

2. What is your baby's date of birth? _____/_____/_____
   Day Month Year

3. How are you feeding your baby? (for example, *breastfeed myself, breastfeed myself and expressed breastmilk in cup/bottle, infant formula only, formula and breastmilk etc.*)

4. How supportive is your partner of your baby's feeding arrangements?
   Please circle one number

   0 (Not at all) 1 2 (somewhat) 3 4 5 (completely) OR Not applicable ❍

   Comments:

5. Where does your baby sleep *most* of the time at **night**?

   Own cot or bed in my room ❍
   Own cot or bed in their own room ❍
   Own cot or bed in another room with others ❍
   In my bed ❍
   In my bed, but in a carrier, basket or wahakura ❍
   Other – please state where: ❍ _____

6. **In the last week** on how many nights did your baby start their **night** sleep in one location, and then move to another location during the night? (For example, gone to sleep in own cot, then moved to your bed and gone to sleep again).

	NO NIGHTS							EVERY NIGHT
Circle the number of nights	0	1	2	3	4	5	6	7

7. If you circled anything **higher than 0** in question 4., what were the reasons you changed your baby's sleep location? (Feel free to list more than one).

8. Where does your baby sleep *most* of the time during the **day**?

   Own cot or bed in my room ❍
   Own cot or bed in another room of their own ❍
   Own cot or bed in another room with others ❍
   In my bed ❍
   With me or another person e.g. being held or in a sling ❍
   Moving around with me e.g. in a pram or basket ❍
   Other – please state where: ❍ _____

9. How often do you and your partner agree on your baby's sleeping location?
   Please circle one number

   0 (Never) 1 (hardly ever) 2 (some of the time) 3 (most of the time) 4 (all of the time) OR Not applicable ❍

   Comments:

10. How often do you and your partner agree on how to manage your baby's sleep?
    Please circle one number

    0 (Never) 1 (hardly ever) 2 (some of the time) 3 (most of the time) 4 (all of the time) OR Not applicable ❍

    Comments:

11. How often **in the last seven days** did you:

*Please circle one number in **every row**.*

		NO NIGHTS							EVERY NIGHT
a.	have difficulty getting to sleep	0	1	2	3	4	5	6	7
b.	wake up during your sleep period	0	1	2	3	4	5	6	7
c.	wake up too early at the end of a sleep period	0	1	2	3	4	5	6	7
d.	feel rested upon awakening at the end of a sleep period	0	1	2	3	4	5	6	7
e.	sleep poorly	0	1	2	3	4	5	6	7
f.	feel sleepy during the day	0	1	2	3	4	5	6	7
g.	struggle to stay awake during the day	0	1	2	3	4	5	6	7
h.	feel irritable during the day	0	1	2	3	4	5	6	7
i.	feel tired or fatigued during the day	0	1	2	3	4	5	6	7
j.	feel satisfied with the quality of your sleep	0	1	2	3	4	5	6	7
k.	feel alert and energetic during the day	0	1	2	3	4	5	6	7
l.	get too much sleep	0	1	2	3	4	5	6	7
m.	get too little sleep	0	1	2	3	4	5	6	7
n.	take a nap at a scheduled time	0	1	2	3	4	5	6	7
o.	fall asleep at an unscheduled time	0	1	2	3	4	5	6	7
p.	drink an alcoholic beverage to help you get to sleep	0	1	2	3	4	5	6	7
q.	use tobacco to help you get to sleep	0	1	2	3	4	5	6	7
r.	use herbal product to help you get to sleep	0	1	2	3	4	5	6	7
s.	use an over-the-counter sleeping pill to help you get to sleep	0	1	2	3	4	5	6	7
t.	use a prescription sleeping pill to help you get to sleep	0	1	2	3	4	5	6	7
u.	use aspirin or other pain medication to help you get to sleep	0	1	2	3	4	5	6	7

12. Please tick the answer which comes closest to how you have felt **in the last seven days**, not just how you feel today.

a. I have been able to laugh and see the funny side of things.

- ○ As much as I always could
- ○ Not quite so much now
- ○ Definitely not so much now
- ○ Not at all

b. I have looked forward with enjoyment to things.

- ○ As much as I ever did
- ○ Rather less than I used to
- ○ Definitely less than I used to
- ○ Hardly at all

c. I have blamed myself unnecessarily when things went wrong.

- ○ Yes, most of the time
- ○ Yes, some of the time
- ○ Not very often
- ○ No, never

d. I have been anxious or worried for no good reason.

- ○ No, not at all
- ○ Hardly ever
- ○ Yes, sometimes
- ○ Yes, very often

e. I have felt scared or panicky for not very good reason.

- ○ Yes, quite a lot
- ○ Yes, sometimes
- ○ No, not much
- ○ No, not at all

f. Things have been getting on top of me.

- ○ Yes, most of the time I haven't been able to cope at all
- ○ Yes, sometimes I haven't been coping as well as usual
- ○ No, most of the time I have coped quite well
- ○ No, I have been coping as well as ever

c. My worrying leads me to feel down and depressed.

O Not true at all O Somewhat true O Moderately true O Definitely true

d. When I worry, it interferes with my ability to make decisions or solve problems.

O Not true at all O Somewhat true O Moderately true O Definitely true

e. I feel tense and anxious when I worry.

O Not true at all O Somewhat true O Moderately true O Definitely true

f. I worry that bad things or events are certain to happen.

O Not true at all O Somewhat true O Moderately true O Definitely true

g. I often worry about not being able to stop myself from worrying.

O Not true at all O Somewhat true O Moderately true O Definitely true

h. As a consequence of my worrying, I tend to feel emotional unease or discomfort.

O Not true at all O Somewhat true O Moderately true O Definitely true

14. Which of the following has your baby had during **the last seven days**?

Tick all that apply

O Fever (high temperature)
O Diarrhoea
O Vomiting
O Ear infection
O Colic
O Fussy or irritable
O Reflux
O Runny nose or cold
O Cough or wheeze
O Chest infection
O Asthma
O Food allergy
O Eczema (atopic dermatitis)
O None of these

MASSEY UNIVERSITY ID:_____

c. My worrying leads me to feel down and depressed.

O Not true at all O Somewhat true O Moderately true O Definitely true

d. When I worry, it interferes with my ability to make decisions or solve problems.

O Not true at all O Somewhat true O Moderately true O Definitely true

e. I feel tense and anxious when I worry.

O Not true at all O Somewhat true O Moderately true O Definitely true

f. I worry that bad things or events are certain to happen.

O Not true at all O Somewhat true O Moderately true O Definitely true

g. I often worry about not being able to stop myself from worrying.

O Not true at all O Somewhat true O Moderately true O Definitely true

h. As a consequence of my worrying, I tend to feel emotional unease or discomfort.

O Not true at all O Somewhat true O Moderately true O Definitely true

14. Which of the following has your baby had during **the last seven days**?

Tick all that apply

O Fever (high temperature)
O Diarrhoea
O Vomiting
O Ear infection
O Colic
O Fussy or irritable
O Reflux
O Runny nose or cold
O Cough or wheeze
O Chest infection
O Asthma
O Food allergy
O Eczema (atopic dermatitis)
O None of these

PIPIS Questionnaire 2 Ed V2 24/06/10 Page | 6/8
Sleep/Wake Research Centre, Massey University, PO Box 756, Wellington, 6140 | mumsleep@massey.ac.nz

15. Did your baby receive any of the following medicines in the last **2 weeks**? *(Please do not include vitamins or minerals).*

	Yes	No
Antibiotics	❍	❍
Other prescription medicine	❍	❍
Non-prescription medicine	❍	❍
6 week immunisations	❍	❍

16. If you answered "yes" to immunisations, on what date were these given? ____/____/____ Day Month Year

17. Which strategies from the information booklet or session have you tried when it comes to **your own sleep** since you have had your baby?

Please put a tick (✓) next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

18. Which strategies from the information booklet or session have you tried when it comes to **your baby's sleep**?

Please put a tick (✓) next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

MASSEY UNIVERSITY ID:_____

19. In general do you consider **your own sleep** to be:

A very serious problem ❍ A small problem ❍ No problem at all ❍

20. In general do you consider **your baby's sleep** to be:

A very serious problem ❍ A small problem ❍ No problem at all ❍

21. Please list any other sources of information you have had access to about **baby sleep** in the last six weeks (including book titles, internet sites, specific people):

Please put a tick (✓) next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Please take a moment now to flick through every page of this survey and check that you have answered all the questions you meant to.

A $20 voucher, from the choice of three options below, will be posted to you when we receive this completed questionnaire. Please ensure you have advised us of any change of address details.

Please indicate the type of voucher you would prefer (tick one):

Petrol (MTA) ☐ Supermarket (New World) ☐ Department store (Farmers) ☐

Important note

If you feel concerned about any of the issues raised by completing this questionnaire, we suggest that you discuss these with your Lead Maternity Carer, doctor or other health professional.

PĪPĪS Project

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

6-weeks Questionnaire

1. Today's date _____/_____/_____
   Day Month Year

2. What is your baby's date of birth? _____/_____/_____
   Day Month Year

3. How are you feeding your baby? (for example, *breastfeed myself, breastfeed myself and expressed breastmilk in cup/bottle, infant formula only, formula and breastmilk etc.*)

4. How supportive is your partner of your baby's feeding arrangements?
   Please circle one number

   0 1 2 3 4 5 OR Not applicable ❍
   Not at all somewhat completely

   Comments:

5. Where does your baby sleep *most* of the time at **night**?

   Own cot or bed in my room ❍
   Own cot or bed in their own room ❍
   Own cot or bed in another room with others ❍
   In my bed ❍
   In my bed, but in a carrier, basket or wahakura ❍
   Other – please state where: ❍ _____

6. **In the last week** on how many nights did your baby start their **night** sleep in one location, and then move to another location during the night? (For example, gone to sleep in own cot, then moved to your bed and gone to sleep again).

	NO NIGHTS							EVERY NIGHT
Circle the number of nights	0	1	2	3	4	5	6	7

7. If you circled anything **higher than 0** in question 6., what were the reasons you changed your baby's sleep location? (Feel free to list more than one).

8. Where does your baby sleep *most* of the time during the **day**?

   Own cot or bed in my room ❍
   Own cot or bed in another room of their own ❍
   Own cot or bed in another room with others ❍
   In my bed ❍
   With me or another person e.g. being held or in a sling ❍
   Moving around with me e.g. in a pram or basket ❍
   Other – please state where: ❍ _____

9. How often do you and your partner agree on your baby's sleeping location?
   Please circle one number

   0 1 2 3 4 OR Not applicable ❍
   Never hardly ever some of the time most of the time all of the time

   Comments:

10. How often do you and your partner agree on how to manage your baby's sleep?
    Please circle one number

    0 1 2 3 4 OR Not applicable ❍
    Never hardly ever some of the time most of the time all of the time

    Comments:

Control group version

11. How often **in the last seven days** did you:

Please circle one number in every row.

		NO NIGHTS							EVERY NIGHT
a.	have difficulty getting to sleep	0	1	2	3	4	5	6	7
b.	wake up during your sleep period	0	1	2	3	4	5	6	7
c.	wake up too early at the end of a sleep period	0	1	2	3	4	5	6	7
d.	feel rested upon awakening at the end of a sleep period	0	1	2	3	4	5	6	7
e.	sleep poorly	0	1	2	3	4	5	6	7
f.	feel sleepy during the day	0	1	2	3	4	5	6	7
g.	struggle to stay awake during the day	0	1	2	3	4	5	6	7
h.	feel irritable during the day	0	1	2	3	4	5	6	7
i.	feel tired or fatigued during the day	0	1	2	3	4	5	6	7
j.	feel satisfied with the quality of your sleep	0	1	2	3	4	5	6	7
k.	feel alert and energetic during the day	0	1	2	3	4	5	6	7
l.	get too much sleep	0	1	2	3	4	5	6	7
m.	get too little sleep	0	1	2	3	4	5	6	7
n.	take a nap at a scheduled time	0	1	2	3	4	5	6	7
o.	fall asleep at an unscheduled time	0	1	2	3	4	5	6	7
p.	drink an alcoholic beverage to help you get to sleep	0	1	2	3	4	5	6	7
q.	use tobacco to help you get to sleep	0	1	2	3	4	5	6	7
r.	use herbal product to help you get to sleep	0	1	2	3	4	5	6	7
s.	use an over-the-counter sleeping pill to help you get to sleep	0	1	2	3	4	5	6	7
t.	use a prescription sleeping pill to help you get to sleep	0	1	2	3	4	5	6	7
u.	use aspirin or other pain medication to help you get to sleep	0	1	2	3	4	5	6	7

12. Please tick the answer which comes closest to how you have felt **in the last seven days**, not just how you feel today.

a. I have been able to laugh and see the funny side of things.

- ○ As much as I always could
- ○ Not quite so much now
- ○ Definitely not so much now
- ○ Not at all

b. I have looked forward with enjoyment to things.

- ○ As much as I ever did
- ○ Rather less than I used to
- ○ Definitely less than I used to
- ○ Hardly at all

c. I have blamed myself unnecessarily when things went wrong.

- ○ Yes, most of the time
- ○ Yes, some of the time
- ○ Not very often
- ○ No, never

d. I have been anxious or worried for no good reason.

- ○ No, not at all
- ○ Hardly ever
- ○ Yes, sometimes
- ○ Yes, very often

e. I have felt scared or panicky for not very good reason.

- ○ Yes, quite a lot
- ○ Yes, sometimes
- ○ No, not much
- ○ No, not at all

f. Things have been getting on top of me.

- ○ Yes, most of the time I haven't been able to cope at all
- ○ Yes, sometimes I haven't been coping as well as usual
- ○ No, most of the time I have coped quite well
- ○ No, I have been coping as well as ever

g. I have been so unhappy that I have had difficulty sleeping.

- ○ Yes, most of the time
- ○ Yes, sometimes
- ○ Not very often
- ○ No, not at all

h. I have felt sad or miserable.

- ○ Yes, most of the time
- ○ Yes, quite often
- ○ Not very often
- ○ No, not at all

i. I have been so unhappy that I have been crying.

- ○ Yes, most of the time
- ○ Yes, quite often
- ○ Only occasionally
- ○ No, never

j. The thought of harming myself has occurred to me.

- ○ Yes, quite often
- ○ Sometimes
- ○ Hardly ever
- ○ Never

13. The following are statements about worrying. Please read each statement and indicate how true each one is in describing your **general/usual** experience of worrying. *Please tick the one option that most likely applies to you for each statement.*

a. When I worry, it interferes with my day-to-day functioning (e.g. stops me getting my work done, organising myself or my activities).

○ Not true at all ○ Somewhat true ○ Moderately true ○ Definitely true

b. When I think I should be finished worrying about something, I find myself worrying about the same thing, over and over.

○ Not true at all ○ Somewhat true ○ Moderately true ○ Definitely true

...continued on next page

c. My worrying leads me to feel down and depressed.

○ Not true at all ○ Somewhat true ○ Moderately true ○ Definitely true

d. When I worry, it interferes with my ability to make decisions or solve problems.

○ Not true at all ○ Somewhat true ○ Moderately true ○ Definitely true

e. I feel tense and anxious when I worry.

○ Not true at all ○ Somewhat true ○ Moderately true ○ Definitely true

f. I worry that bad things or events are certain to happen.

○ Not true at all ○ Somewhat true ○ Moderately true ○ Definitely true

g. I often worry about not being able to stop myself from worrying.

○ Not true at all ○ Somewhat true ○ Moderately true ○ Definitely true

h. As a consequence of my worrying, I tend to feel emotional unease or discomfort.

○ Not true at all ○ Somewhat true ○ Moderately true ○ Definitely true

14. Which of the following has your baby had during **the last seven days**?

Tick all that apply

- ○ Fever (high temperature)
- ○ Diarrhoea
- ○ Vomiting
- ○ Ear infection
- ○ Colic
- ○ Fussy or irritable
- ○ Reflux
- ○ Runny nose or cold
- ○ Cough or wheeze
- ○ Chest infection
- ○ Asthma
- ○ Food allergy
- ○ Eczema (atopic dermatitis)
- ○ None of these

15. Did your baby receive any of the following medicines in **the last 2 weeks**? *(Please do not include vitamins or minerals).*

	Yes	No
Antibiotics	❍	❍
Other prescription medicine	❍	❍
Non-prescription medicine	❍	❍
6-week immunisations	❍	❍

16. If you answered "yes" to immunisations, on what date were these given? _____/_____/_____
Day Month Year

17. Have you followed any tips or tried any particular techniques or strategies when it comes to helping **your own sleep** since you have had your baby?

Please put a tick (✓) next to any of the tips, techniques or strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

18. Have you followed any tips or tried any particular techniques or strategies when it comes to helping **your baby's sleep**?

Please put a tick (✓) next to any of the tips, techniques or strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments:

19. In general do you consider **your own sleep** to be:

A very serious problem ❍ A small problem ❍ No problem at all ❍

20. In general do you consider **your baby's sleep** to be:

A very serious problem ❍ A small problem ❍ No problem at all ❍

21. Please list any sources of information you have had access to about **baby sleep** in the last six weeks (including book titles, internet sites, specific people):

Please put a tick (✓)next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Please take a moment now to flick through every page of this survey and check that you have answered all the questions you meant to.

A $20 voucher, from the choice of three options below, will be posted to you when we receive this completed questionnaire. Please ensure you have advised us of any change of address details.

Please indicate the type of voucher you would prefer (tick one):

Petrol (MTA) ☐ Supermarket (New World) ☐ Department store (Farmers) ☐

Important note

If you feel concerned about any of the issues raised by completing this questionnaire, we suggest that you discuss these with your Lead Maternity Carer, doctor or other health professional.

MASSEY UNIVERSITY ID:_____

PĪPĪS Project

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

12-weeks Questionnaire

1. Today's date _____/_____/_____
   Day Month Year

2. What is your baby's date of birth? _____/_____/_____
   Day Month Year

3. How are you feeding your baby? (for example, *breastfeed myself, breastfeed myself and expressed breastmilk in cup/bottle, infant formula only, formula and breastmilk etc.*).

4. How supportive is your partner of your baby's feeding arrangements?
   Please circle one number

   0 Not at all 1 2 somewhat 3 4 5 completely OR Not applicable ❍

   Comments:

5. Where does your baby sleep *most* of the time at **night**?

   Own cot or bed in my room ❍
   Own cot or bed in their own room ❍
   Own cot or bed in another room with others ❍
   In my bed ❍
   In my bed, but in a carrier, basket or wahakura ❍
   Other – please state where: ❍ _____

MASSEY UNIVERSITY ID:_____

6. Where does your baby sleep *most* of the time during the **day**?

   Own cot or bed in my room ❍
   Own cot or bed in another room of their own ❍
   Own cot or bed in another room with others ❍
   In my bed ❍
   With me or another person e.g. being held or in a sling ❍
   Moving around with me e.g. in a pram or basket ❍
   Other – please state where: ❍ _____

7. How often do you and your partner agree on your baby's sleeping location?
   Please circle one number

   0 Never 1 hardly ever 2 some of the time 3 most of the time 4 all of the time OR Not applicable ❍

   Comments:

8. How often do you and your partner agree on how to manage your baby's sleep?
   Please circle one number

   0 Never 1 hardly ever 2 some of the time 3 most of the time 4 all of the time OR Not applicable ❍

   Comments:

9. Has your baby receive any immunisations **in the last 2 weeks**?
   Yes ❍ No ❍

10. If you answered "yes" to immunisations, on what date were these given? _____/_____/_____
    Day Month Year

11. Which strategies from the information booklet or session have you tried when it comes to **your own sleep** since you have had your baby?

Please put a tick (✓)next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

12. Which strategies from the information booklet or session have you tried when it comes to **your baby's sleep**?

Please put a tick (✓) next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

13. In general do you consider **your own sleep** to be:

A very serious problem ❍ A small problem ❍ No problem at all ❍

14. In general do you consider **your baby's sleep** to be:

A very serious problem ❍ A small problem ❍ No problem at all ❍

15. Please list any other sources of information you have had access to about **baby sleep** in the last six weeks (including book titles, internet sites, specific people):

Please put a tick (✓) next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

Please take a moment now to flick through every page of this survey and check that you have answered all the questions you meant to.

A $20 voucher, from the choice of three options below, will be posted to you when we receive this completed questionnaire. Please ensure you have advised us of any change of address details.

Please indicate the type of voucher you would prefer (tick one):

Petrol (MTA) ☐ Supermarket (New World) ☐ Department store (Farmers) ☐

Important note

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MASSEY UNIVERSITY ID:_____

PĪPĪS Project

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

12-weeks Questionnaire

1. Today's date _____/_____/_____
   Day Month Year

2. What is your baby's date of birth? _____/_____/_____
   Day Month Year

3. How are you feeding your baby? (for example, *breastfeed myself, breastfeed myself and expressed breastmilk in cup/bottle, infant formula only, formula and breastmilk etc.*).

4. How supportive is your partner of your baby's feeding arrangements?
   Please circle one number

   0 Not at all | 1 | 2 somewhat | 3 | 4 | 5 completely | OR Not applicable ❍

   Comments:

5. Where does your baby sleep *most* of the time at **night**?

   - Own cot or bed in my room ❍
   - Own cot or bed in their own room ❍
   - Own cot or bed in another room with others ❍
   - In my bed ❍
   - In my bed, but in a carrier, basket or wahakura ❍
   - Other – please state where: ❍ _____

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6. Where does your baby sleep *most* of the time during the **day**?

   - Own cot or bed in my room ❍
   - Own cot or bed in another room of their own ❍
   - Own cot or bed in another room with others ❍
   - In my bed ❍
   - With me or another person e.g. being held or in a sling ❍
   - Moving around with me e.g. in a pram or basket ❍
   - Other – please state where: ❍ _____

7. How often do you and your partner agree on your baby's sleeping location?
   Please circle one number

   0 Never | 1 hardly ever | 2 some of the time | 3 most of the time | 4 all of the time | OR Not applicable ❍

   Comments:

8. How often do you and your partner agree on how to manage your baby's sleep?
   Please circle one number

   0 Never | 1 hardly ever | 2 some of the time | 3 most of the time | 4 all of the time | OR Not applicable ❍

   Comments:

9. Has your baby received any immunisations **in the last 2 weeks**?

   Yes ❍ No ❍

10. If you answered "yes" to immunisations, on what date were these given? _____/_____/_____
    Day Month Year

11. Have you followed any tips or tried any particular techniques or strategies when it comes to helping **your own sleep** since you have had your baby?

Please put a tick (✓) next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

12. Have you followed any tips or tried any particular techniques or strategies when it comes to helping **your baby's sleep**?

Please put a tick (✓) next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

13. In general do you consider **your own sleep** to be:

A very serious problem ❍ A small problem ❍ No problem at all ❍

14. In general do you consider **your baby's sleep** to be:

A very serious problem ❍ A small problem ❍ No problem at all ❍

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15. Please list any sources of information you have had access to about **baby sleep** since your baby was born (including book titles, internet sites, specific people):

Please put a tick (✓) next to any of the strategies that you have listed above that were helpful, and an **X** next to any which you tried but didn't find helpful.

Comments welcome:

Please take a moment now to flick through every page of this survey and check that you have answered all the questions you meant to.

A $20 voucher, from the choice of three options below, will be posted to you when we receive this completed questionnaire. Please ensure you have advised us of any change of address details.

Please indicate the type of voucher you would prefer (tick one):

Petrol (MTA) ☐ Supermarket (New World) ☐ Department store (Farmers) ☐

Important note

If you feel concerned about any of the issues raised by completing this questionnaire, we suggest that you discuss these with your Lead Maternity Carer, doctor or other health professional.

Appendix 17:
PIPIS sleep diaries

Diary number: **SAMPLE DIARY**

Date started: 13/04/10

Infant Sleep Diary

IMMUNISATION: Your baby may be due for immunisations at 6-weeks and 3 months of age. Wherever possible please schedule immunisations for the days *after* these actigraphy days.

For each day, please mark the following times and events:

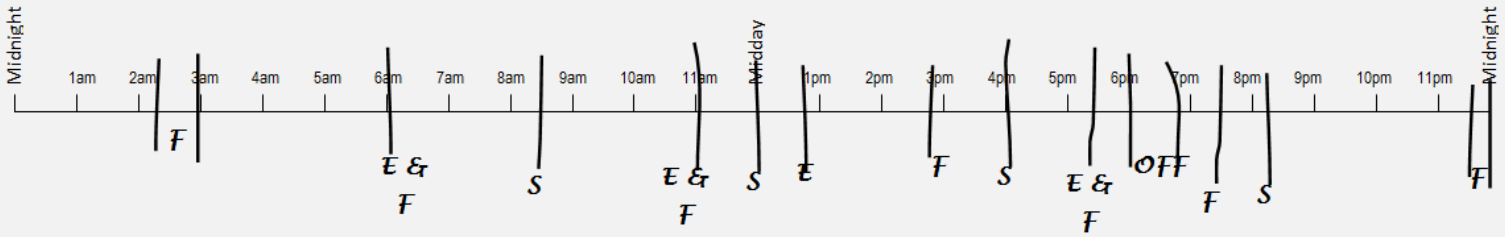
1. When your baby started an intended sleep (**S**) and ended the intended sleep (**E**) for any sleep **10 minutes or longer**.
2. Times when the Actiwatch was removed, for example when bathing (**OFF**).
3. Times when your baby was feeding (**F**).
4. Note where your baby slept at night (between 7pm and 7am).
5. Any notes or events of interest for that day – e.g. it was a particularly busy day.
6. Please also note any times when your baby was in the care of another person (this may affect diary keeping).

NOTE: Night sleeps may start on the row of one day, and finish on the row for the next day.

EXAMPLE: A baby finished sleeping at 6am (**E**) and started the next sleep at 8.30am (**S**). She finished this sleep at 11am (**E**). She fell asleep at midday (**S**) in the car, and woke up at 12.45pm. She was awake until 4pm when she was put to bed for a sleep (**S**). She woke up at 5.30pm (**E**) and then the Actiwatch was removed while she had a bath between 6 and 6.45pm (**OFF**). She was put to bed for the night at 8.15pm. The baby had feeds at 2.20am, 6am, 11am, 3pm, 5.30pm, 7.30pm and 11.45pm. During the night starting this timeline she had gone to sleep in her own bed in her own room and then moved to her parents' bed at 2.20am where she stayed until 6am.

Notes or events of interest from the day of monitoring

Was in her dad's care from 11.30 to 4pm, and he kept the diary up to date.



Places your baby slept during the night (from 7pm to 7am): *Went to bed in own bed at 8pm, came into our bed at 2.20am feed, till 6am.*

Diary number_____

Start date:_____

Infant's Sleep Diary

IMMUNISATION: Your baby may be due for immunisations at 6-weeks and 3 months of age. Wherever possible please schedule immunisations for the days *after* these actigraphy days.

For each day, please mark the following times and events:

1. When your baby started an intended sleep (**S**) and ended the intended sleep (**E**) for any sleep **10 minutes or longer**.
2. Times when the Actiwatch was removed, for example when bathing (**OFF**).
3. Times when your baby was feeding (**F**).
4. Note where your baby slept at night (between 7pm and 7am).
5. Any notes or events of interest for that day – e.g. it was a particularly busy day – in the boxes below on this page.
6. Please also note any times when your baby was in the care of another person (this may affect diary keeping).

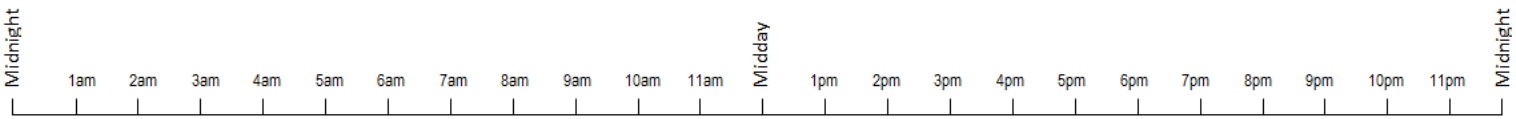
NOTE: Night sleeps may start on the row of one day, and finish on the row for the next day.

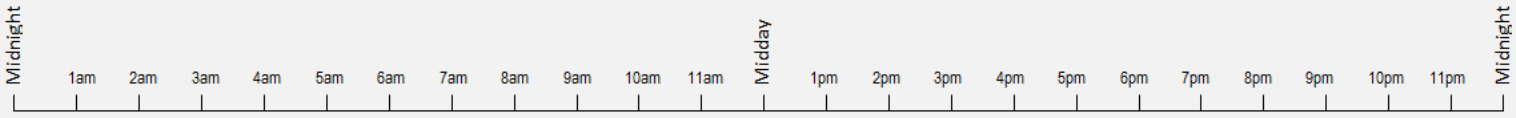
Notes or events of interest from the first day of monitoring	Notes or events of interest from the middle day of monitoring	Notes or events of interest from the last day of monitoring

Infant's Sleep Diary Diary number_____ Start Date _____/_____/_____

DIARY COMPLETION: Please ensure you complete this diary for exactly the same time period and in the same way as your own diary.

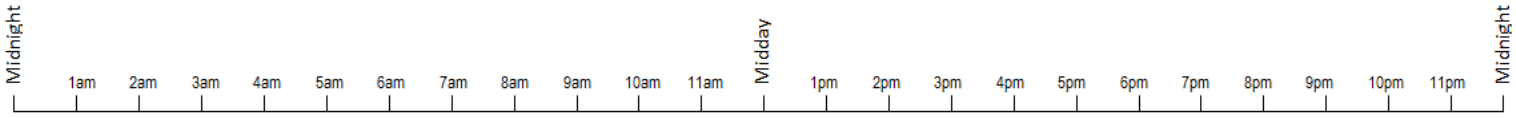
FIRST DAY OF MONITORING





Places your baby slept during the night (from 7pm to 7am):_____

LAST DAY OF MONITORING



Places your baby slept during the night (from 7pm to 7am):_____

PLEASE MARK THE FOLLOWING ON THE TIMELINE ABOVE: **S** Started a sleep **E** Ended a sleep **F** Feeding **OFF** Anytime the Actiwatch was removed

Diary number: **SAMPLE DIARY**

DIARY COMPLETION: Please ensure you complete this diary for exactly the same time period as your baby's diary.

Start date: 13/04/10

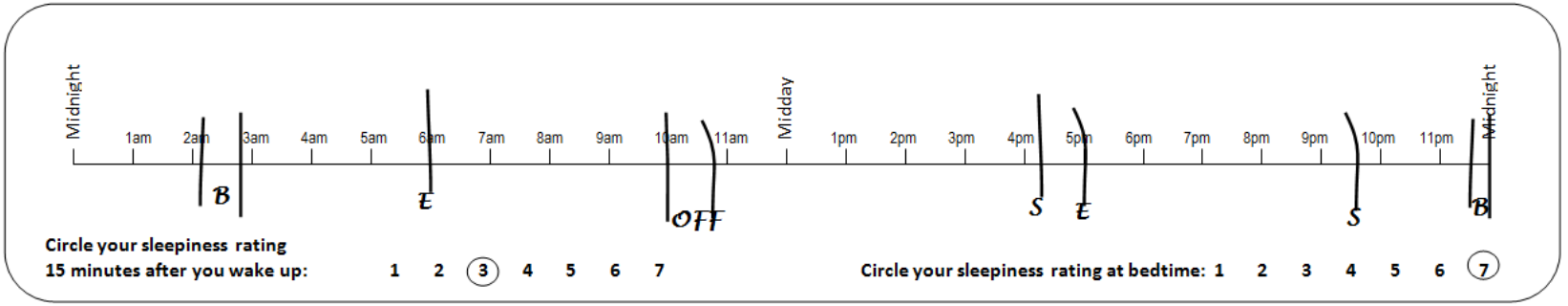
Mother's Sleep Diary

For each day, please complete a whole row, and mark the following times:

1. When you started a sleep (**S**) (or trying to sleep) and ended the sleep (**E**) for any sleep **10 minutes or longer**.
2. Times when you were up from your sleep at night to attend to the baby (**B**).
3. Times when the actiwatch was removed, for example when showering (**OFF**).
4. Circle your sleepiness rating on going to bed each night, and 15 minutes after you wake up for the day each morning. See the time-line page for ratings.

NOTE: Night sleeps may start on the row of one day, and finish on the row for the next day.

EXAMPLE: A mother did a night feed which took from 2.20 to 2.45am after which she went straight back to sleep. She was woken up at 6am by her baby and this is when she started her day. She took the Actiwatch off for a shower at 10am. At 4.15pm she fell asleep on the couch for ¾ hr. She went to bed for the night at 9.45pm, and was woken at 11.45pm to feed the baby. She rated her sleepiness in the morning as a '3' and before going to bed for the night as a '7'.



Please mark the following on the timeline above: **S** Started a sleep **E** Ended a sleep **B** Night baby care/feeding **OFF** Anytime the actiwatch was removed

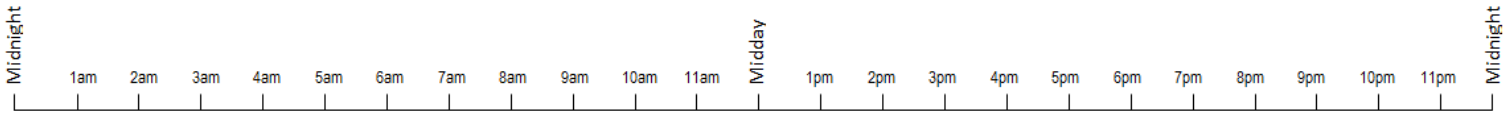
Sleepiness ratings: **1** Feeling active, vital, alert or wide awake **2** Functioning at high levels, but not at peak; able to concentrate **3** Awake, but relaxed; responsive but not fully alert
4 Somewhat foggy, let down **5** Foggy; losing interest in remaining awake; slowed down **6** Sleepy, woozy, fighting sleep; prefer to lie down
7 No longer fighting sleep, sleep onset soon, having dream-like thoughts

Mother's Sleep Diary

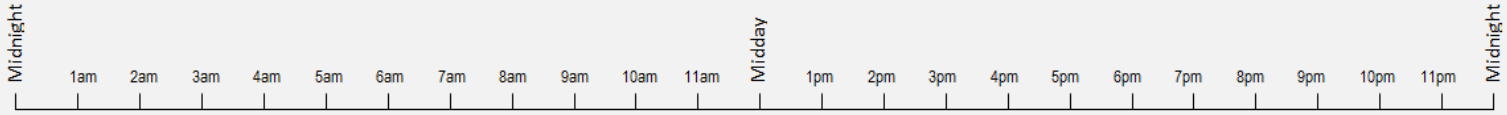
Diary number_____ Start Date _____/_____/_____

DIARY COMPLETION: Please ensure you complete this diary for exactly the same time period and in the same way as your baby's diary.

FIRST DAY OF MONITORING



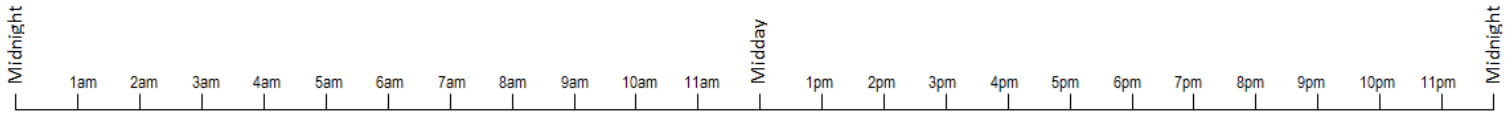
Circle your sleepiness rating at bedtime: 1 2 3 4 5 6 7



Circle your sleepiness rating 15 minutes after you wake up: 1 2 3 4 5 6 7

Circle your sleepiness rating at bedtime: 1 2 3 4 5 6 7

LAST DAY OF MONITORING



Circle your sleepiness rating 15 minutes after you wake up: 1 2 3 4 5 6 7

Please mark the following on the timeline above: **S** Started a sleep **E** Ended a sleep **F** Feeding **OFF** Anytime the actiwatch was removed

Sleepiness ratings: **1** Feeling active, vital, alert or wide awake **2** Functioning at high levels, but not at peak; able to concentrate **3** Awake, but relaxed; responsive but not fully alert
4 Somewhat foggy, let down **5** Foggy; losing interest in remaining awake; slowed down **6** Sleepy, woozy, fighting sleep; prefer to lie down
7 No longer fighting sleep, sleep onset soon, having dream-like thoughts

MASSEY UNIVERSITY

'SLEEP~WAKE'
'MOE TIKA~MOE PAI'

Information about Actiwatch and Sleep Diary use

The Actiwatch contains a small activity monitor (accelerometer) and memory chip and it records movement. Data from the Actiwatch is analysed in conjunction with what you record in the sleep diary for yourself and your baby. This gives us information about the amount and quality of sleep you and your baby obtain. Please note the Actiwatches will be sterilised prior to being delivered to you, and the baby band provided is brand new for each infant.

The data from the Actiwatch is analysed along with the information from the sleep diaries to determine when and how well both have slept.

Actiwatch information for adult use:

1. Please wear the Actiwatch on your non-dominant wrist (the hand you **don't** write with).
2. Place the Actiwatch on your wrist with the event marker (small silver button on the side) closest to your thumb.
3. The Actiwatch is worn with the face on the outside of their wrist. It should be attached reasonably firmly so that it does not move about on your wrist. If it does move about, tighten the strap slightly.

Actiwatch information for infant use:

4. The Actiwatch should be inserted within the band with the black side next to the black dot on the strap. This way, you can push on the event marker (round button on the face of the Actiwatch) by pushing on the dot. When you push this button, a marker is inserted into the data. It does not stop or start the watch, which will keep going the entire time that you have it.
5. Fit the Actiwatch around either of your baby's legs, just below the knee. Wrap the band around the leg and fasten in place using the Velcro strips. The band can be worn against the skin or over clothing which is well fitted. Once you decide on this placement please continue the same placement for the 48-hour duration – that is always against the skin, or always over clothing.
6. Fit the strap with the face/dot on the outside of your baby's leg. It should be attached reasonably firmly so that it does not move about. If it does move about, or you feel the strap is too tight contact the researcher for other band size options.
7. Please push the event marker when you put your baby down to start trying to sleep and again when they wake up (day or night). We would also like you to press the marker at times when your baby has had an unintentional nap of **10 minutes or longer**.

Information about wearing the Actiwatch for both mothers and babies:

8. The watch is water resistant, not waterproof. This means that it should be removed when bathing or showering or if washing any of the bands. Please remember to put it back on again after contact with water.
9. If you take the watch off for any reason (for example bathing) then please note this in the sleep log (write **OFF**).
10. If you forget to put the watch back on at any stage, please put it on as soon as you remember. Do not worry if you accidentally missed some time – we are interested in as much data as possible so simply note in the sleep log the time when you put the watch back on (write **ON**).
11. We cannot tell what you, or your baby, are doing from the Actiwatch data. We can only tell whether you are moving or not. Please be aware that the Actiwatch does **not** monitor your baby's breathing. It is **not** a tool to provide additional safety or monitoring of your child's sleep and is not fitted with any alarms.

Information about filling out the sleep diary:

For an example of how to complete Sleep Diary please see the first page of your diary sheets.

a. The sleep log is set out so that each line represents 24 hours, from midnight to midnight on one day.

b. Please write the date for each day in the space provided.

c. We are interested in **any** sleep that is **10 minutes or longer**. It does not matter whether this is during the day or during the night.

d. The information that is essential to us are the times that you **put your baby to bed** and **when they woke** up after any sleep that is **10 minutes or longer**. This includes daytime naps and sleeps, as well as night time sleeps.

e. It is also essential that we know when you started trying to sleep and woke up after any sleep that is 10 minutes or longer, including daytime naps and sleeps, as well as night time sleeps.

f. Please place a mark on the line at each of these times and then write underneath what the line relates to for example *sleep* (**S**), with the time in hours and minutes. There are abbreviations listed on the sleep log for each of these events.

g. It is at these start and finish times of sleeps that we would also like you to push the event marker on the Actiwatch (i.e. your corresponding dot!)

h. Some babies will lay awake for some time or play alone once put to bed. We do not expect you to change your routine or observe your baby closely for sleep onset. Simply mark the time they were put to bed or when you noticed that they fell asleep. Again, some babies may not signal immediately that they are awake. Just mark the times you are aware that they are awake (for example if they signal to you in the night) and the time that you get them up for the day.

i. If your baby wakes up momentarily during a sleep period, you do not need to write anything in the sleep log. If you are aware that they wake for **more than 10 minutes** then please treat any later sleep as a new sleep period.

j. For each day, please record any time your baby spent in another person's care. If possible/appropriate, you can pass the log on to other carers to complete, but this is not essential.

k. There is space for you to write any comments you have for the day. We are particularly interested in events which may effect your baby's sleep, for example being in an unusual, stressful or exciting environment, or events which displaced routine sleep times or places.

l. Also included on the Mother's Diary is a scale to record your feelings of sleepiness just prior to going to bed for the night, and just after waking up for the day. Please draw a circle around the number that corresponds to how sleepy you feel at as close to your night bedtime as possible. In the morning please circle your sleepiness rating 15 minutes after you wake up for the day. Explanations of the numeric ratings are shown on the sleep diary pages.

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PIPIS Project

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

Feedback Questionnaire

Dear Parent

Thank you very much for taking part in the PIPIS mother and baby pilot sleep study. As soon as all families have completed the study we will begin to analyse both your sleep and your baby's sleep. In the meantime we would very much appreciate your feedback on the study. Below are some questions and space for you to comment on how you felt the study went and what could be done better.

We encourage you to give full and honest feedback, your comments will help us to make adjustments to our study design and programme for the future.

Once complete could you please post the form back to us in the prepaid envelope provided (or scan and email to b.m.sweeney@massey.ac.nz).

1. Did you feel that the information provided to you prior to this study gave you a full picture of what the study entailed?

   Yes ❍ No ❍

   Comments:

2. Were you satisfied with the answers you received from the researcher to any queries you had concerning the study?

   Yes ❍ No ❍

   Comments:

3. How did you find using the monitors (Actiwatches) and the baby band?

   Easy ❍ Ok ❍ Difficult ❍

   Comments:

MASSEY UNIVERSITY ID: _____

4. How did you find completing the sleep diaries?

   Easy ❍ Ok ❍ Difficult ❍

   Comments:

5. How did you find completing the questionnaires?

   Easy ❍ Ok ❍ Difficult ❍

   Comments:

6. How did you find the telephone call contact?

   Easy ❍ Ok ❍ Difficult ❍

   Comments:

7. How useful were the weekly telephone calls for you?

   Very useful ❍ A bit useful ❍ Not at all useful ❍

   Comments:

8. Would you recommend the sleep information session you had at the start of the study to others?

   Definitely ❍ Maybe ❍ Not at all ❍

   Comments:

9. If you answered 'maybe' or 'not at all' in question 8, what changes could we make so that you might want to recommend the information session to others?

10. Would you recommend the sleep information booklet to others?

Definitely ❍ Maybe ❍ Not at all ❍

Comments:

11. If you answered 'maybe' or 'not at all' in question 10, what changes could we make so that you might want to recommend the information booklet to others?

12. Please rate the following items according to how confident you are to do these on a typical day. (We realise you may not actually need to do these things everyday).

Circle one number in each line:

	Never confident with this (0%)										Always confident with this (100%)
a) Put your baby to bed awake but ready for sleep	0	1	2	3	4	5	6	7	8	9	10
b) Recognise your baby's tired signs and cues	0	1	2	3	4	5	6	7	8	9	10
c) Use a range of strategies to help your baby get to sleep **NOT** using feeding or holding/cuddling	0	1	2	3	4	5	6	7	8	9	10
d) Agree with your partner about managing your baby's sleep	0	1	2	3	4	5	6	7	8	9	10
e) Find support for problems with infant sleep	0	1	2	3	4	5	6	7	8	9	10
f) Are happy with your baby's sleep development (e.g. night waking, ability to self settle etc.)	0	1	2	3	4	5	6	7	8	9	10

13. The study you have just participated in included a trial of an education programme aimed at promoting the sleep of recent mothers and their babies. How successful has the programme been for you in terms of helping you with your sleep and your baby's sleep?

Very helpful ❍ A bit helpful ❍ Not at all helpful ❍

Please comment:

14. Any other comments?

If you still have any specific comments or concerns that you do not wish to record here, or that you would like a response to, you are welcome to contact Bronwyn Sweeney, or any of the other research team members listed below.

Finally, ***thank you*** once again for your participation. We would like to extend our best wishes to you and your family.

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PIPIS Project

Sleep and health in new mothers and their babies in Aotearoa/New Zealand

Feedback Questionnaire

Dear Parent

Thank you very much for taking part in the PIPIS mother and baby pilot sleep study. As soon as all families have completed the study we will begin to analyse both your sleep and your baby's sleep. In the meantime we would very much appreciate your feedback on the study. Below are some questions and space for you to comment on how you felt the study went and what could be done better.

We encourage you to give full and honest feedback, your comments will help us to make adjustments to our study design and programme for the future.

Once complete could you please post the form back to us in the prepaid envelope provided (or scan and email to b.m.sweeney@massey.ac.nz).

1. Did you feel that the information provided to you prior to this study gave you a full picture of what the study entailed?

   Yes ❍ No ❍

   Comments:

2. Were you satisfied with the answers you received from the researcher to any queries you had concerning the study?

   Yes ❍ No ❍

   Comments:

3. How did you find using the monitors (Actiwatches) and the baby band?

   Easy ❍ Ok ❍ Difficult ❍

   Comments:

4. How did you find completing the sleep diaries?

   Easy ❍ Ok ❍ Difficult ❍

   Comments:

5. How did you find completing the questionnaires?

   Easy ❍ Ok ❍ Difficult ❍

   Comments:

6. How did you find the telephone contacts?

   Easy ❍ Ok ❍ Difficult ❍

   Comments:

7. Would you recommend the sleep information session you had at the start of the study to others?

   Definitely ❍ Maybe ❍ Not at all ❍

   Comments:

8. If you answered 'maybe' or 'not at all' in question 7, what changes could we make so that you might recommend the information session to others?

9. Please rate the following items according to how confident you are to do these on a typical day. (We realise you may not actually need to do these things everyday).

Circle one number in each line:

	Never confident with this (0%)									Always confident with this (100%)
a) Put your baby to bed awake but ready for sleep	0	1	2	3	4	5	6	7	8	9	10
b) Recognise your baby's tired signs and cues	0	1	2	3	4	5	6	7	8	9	10
c) Use a range of strategies to help your baby get to sleep **NOT** using feeding or holding/cuddling	0	1	2	3	4	5	6	7	8	9	10
d) Agree with your partner about managing your baby's sleep	0	1	2	3	4	5	6	7	8	9	10
e) Find support for problems with infant sleep	0	1	2	3	4	5	6	7	8	9	10
f) Are happy with your baby's sleep development (e.g. night waking, ability to self settle etc.)	0	1	2	3	4	5	6	7	8	9	10

10. Any other comments?

If you still have any specific comments or concerns that you do not wish to record here, or that you would like a response to, you are welcome to contact Bronwyn Sweeney, or any of the other research team members listed over.

Finally, ***thank you*** once again for your participation. We would like to extend our best wishes to you and your family.

MASSEY UNIVERSITY ID: _____

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PIPIS Feedback Form C V3 08/02/11 Page | 4/4
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Appendix 20

PIPIS infant actigraphy scoring guidelines

Infant Actigraphy Scoring (PIPIS)

- Nocturnal sleep time (21:00-09:00)
- Daytime sleep time
- Longest nocturnal sleep period without waking
- Longest daytime sleep period without waking
- 24-hour sleep time
- Number of nocturnal awakenings
- 2 nights of sleep were averaged for nocturnal sleep outcomes because variables for the 2 nights were significantly correlated.
- Daytime sleep outcomes determined from second day (had full 12 hours of daytime sleep for evaluation)
- 24 hour sleep time determined by adding hours of daytime sleep from the second day to hours of nocturnal sleep from the second night

Wake Threshold Value	80 – need higher levels of activity to be scored as "wake" because babies are more active than adults	
Feeds	Count the number of feeds for 24 hour period, 1200hr – 1159hr.	Total Feeds 48 hrs
	Count the number of feeds between 2100hr and 0859hr for the two days	Night Feeds
	Count the number of feeds between 0900hr and 2059hr for the middle day (the only whole day of monitoring)	Day feeds
	When a feed immediately precedes or follows a sleep, feed time may look like sleep in actigraphy. Use diary to set Rest Interval.	
Watch off		
Short sleep periods	Sleep periods noted on diary that are less than 10 MINS duration should not be scored (mothers were asked to note sleep periods of 10 MINS or longer, however entries will have been made because baby was put to bed but then got up again within short space of time)	
Day		Longest daytime sleep period without waking
	When a sleep period is noted on diary but actigraphy shows external motion, use times recorded on diary: Mark interval and Insert Rest Interval. Mark interval again using EXACTLY same times and Insert Forced Sleep Interval. *Analysis: can then run analysis with and without Forced Sleep.*	Forced sleep
	When a sleep period is noted on the diary but actigraphy shows a period of external motion within the sleep period, use times recorded on diary and: Mark whole interval and Insert Rest Interval according to diary times. Mark external motion period as an interval and Insert Forced Sleep Interval for the period of external motion.	

	BE AWARE THIS MAY MEAN BRIEF PERIODS OF AWAKE MAY BE INCLUDED AND THUS OVERESTIMATE SLEEP STATS SUCH AS maximum longest day/night sleep period. **If external motion occurs at very beginning of sleep start time, and parent has not noted infant was asleep, assume external motion being used to get infant to sleep and accept Actiware scoring.	
	If sleep appears to have occurred in actigram but is not marked on the diary as either sleep or a feed, mark as sleep in actigraphy	
	Check diary for entries e.g. was asleep in my arms, was in bed but did not settle well – was jiggling bassinette, out walking etc	
	Event marker at start often pressed as baby going to bed so can be followed by lots of activity – decide if external motion or not: eg walking so baby could be asleep or rocking so baby probably not asleep: can score from where sleep appears to start . Event marker at end often pressed after baby up so set interval to where baby sleep offset appears to occur.	
	Only score data between 12:00 and 12:00	
	Dreamfeeds – if disturbance is less than or equal to 10 minutes score do not create new rest intervals – score one long interval with dreamfeed in it.	
	Marker pressed then high activity straight after use actigraphy to set rest interval	
	If there is a quiet period and mother has annotated part of it as sleep check infant diary to see if feeding: otherwise score period as rest interval.	