Exploring the Sleep of Young Children in Aotearoa New Zealand: Associations with Ethnicity and Maternal Depression in and Beyond the Perinatal Period

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ABSTRACT

Sleep plays a vital role in children's health. Sleep development is influenced by a complex interplay of biopsychosocial factors. There is emerging evidence to suggest perinatal depression (PND) is one such factor, but further investigation is needed. In Aotearoa/New Zealand, ethnic inequities in the social determinants of health produce sleep health disparities that are evident from preschool age through adulthood; it is currently unclear whether they exist in infants. To address these research gaps, secondary data from the *Moe Kura: Mother and Child, Sleep and Wellbeing in Aotearoa/New Zealand* study (*Moe Kura*) were analysed in two studies. Kaupapa Māori research principles informed the study designs.

First, sleep health equity, socio-ecological factors associated with infant sleep, and the characteristics of mother-perceived infant sleep problems were investigated using data from 383 Māori and 702 non-Māori mother-infant dyads at 12 weeks postpartum. Next, longitudinal relationships between maternal depression and infant and preschooler sleep health in 262 Māori and 594 non-Māori dyads were examined using data collected during pregnancy, 12 weeks postpartum, and 3 years post-birth. Multivariable and ordinal logistic models assessed the impact of different socio-ecological factors on infant sleep. Binary logistic models examined longitudinal associations between PND and infant and preschooler sleep, adjusting for key socio-demographic variables.

Key developmental markers of infant sleep did not differ by maternal ethnicity. There were some ethnicity-based differences in sleep location. Bed-sharing and several socio-demographic factors were related to different dimensions of infant sleep and mother-perceived sleep problems. Bivariate associations were found between prior and concurrent depressive symptomology and many of the infant and preschooler sleep outcomes. Prenatal depressive symptoms remained independently associated with shorter-than-recommended sleep durations in preschoolers after controlling for key covariates.

Results show sleep at 12 weeks is highly variable and is associated with numerous socio-ecological factors. Sleep appears to be one pathway by which PND confers risk for poor child health outcomes. Findings support the need for more and better perinatal psychological services.

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TERMS AND ABBREVIATIONS

AASM	American Academy of Sleep Medicine
BISQ	Brief Infant Sleep Questionnaire
CSHQ	Children's Sleep Habits Questionnaire
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th Edition
HDEC	New Zealand Central Health and Disability Committee
E Moe, Māmā	E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand study
ECE	Early Childhood Education
LSP	Longest sustained sleep period. An infant's physiological capacity for continuous sleep. Measured with objective measures such as polysomnography.
LSRSP	Longest self-regulated sleep period (period comprises sleep + non-signalled wakings)
Infant	Child aged < 12 months
Kaitiaki	Guardian
Māmā	Mother
MDD	Major depressive disorder
Moe	Sleep
MOH	New Zealand Ministry of Health
Moe Kura	Moe Kura: Mother and Child, Sleep and Wellbeing in Aotearoa/New Zealand study
Night wakings	Non-signalled waking for the purpose of this thesis

Non-signalled wakings	Brief periods of wakefulness at transition points between sleep stages, to which parents/caregivers are not alerted. Usually captured with objective measures such as polysomnography.
NREMS	Non-rapid eye movement sleep
NSF	U.S. National Sleep Foundation
Preschooler	Child aged 3 or 4 years
REMS	Rapid eye movement sleep
SEP	Socio-economic position
Signalled wakings	Wakings to which the parents/caregivers are alerted, usually by the infant crying or calling out.
SOL	Sleep onset latency
SWS	Slow wave sleep
Tamariki	Children
Te Tiriti o Waitangi	The Treaty of Waitangi
Toddler	Child aged 1 or 2 years
Wahine	Women
WASO	Wake after sleep onset

CHAPTER 1 INTRODUCTION

Sleep develops through a complex interplay of biopsychosocial factors (Goodlin-Jones et al., 2001; Hale et al., 2015; Meltzer et al., 2021; Sadeh & Anders, 1993) and plays a vital role in children's health and development (El-Sheikh & Sadeh, 2015). Poor sleep health in early childhood is associated with a myriad of adverse health outcomes, many with long-term implications (Meltzer et al., 2021; Paruthi et al., 2016). In Aotearoa New Zealand (NZ), ethnic inequities in sleep health are evident in adult, adolescent, and preschooler populations (Muller et al., 2019a; Muller et al., 2024; Paine et al., 2016), but it remains unclear when these inequities first emerge, and whether they are present from infancy.

Many of the adverse health outcomes associated with poor sleep health mirror those linked to early exposure to maternal depression (Betts et al., 2014; Korhonen et al., 2012; Leigh & Milgrom, 2008; O'Donnell et al., 2014). Emerging evidence suggests poor sleep health might be a pathway by which established risks of perinatal depression (PND) are transmitted to children (O'Connor et al., 2007; Toffol et al., 2019), but more research is needed. Understanding whether sleep health inequities exist in NZ infants, and how PND might influence child sleep, can help to address established inequities and promote sleep health across the lifespan. Therefore, the primary aim of this thesis is to explore relationships between PND and child sleep, specifically in infants and preschoolers in the NZ context, with a focus on health equity.

1.1 Thesis Contexts

This thesis explores sleep in early childhood and its longitudinal relationships with PND within the unique context of NZ. It uses secondary quantitative data collected from participants in a wider programme of research on maternal and child sleep and health, the *Moe Kura: Mother and Child Sleep and Wellbeing in Aotearoa/New Zealand (Moe Kura)* study. To contextualise this thesis, a brief overview of the societal and research underpinnings of this research are provided below.

Aotearoa New Zealand Context

Te Tiriti o Waitangi/the Treaty of Waitangi, signed in 1840, is a founding document of NZ. It declared a partnership between the Indigenous Māori people of Aotearoa and the colonising British Crown. The Treaty promised Māori control over their resources (article 2), and conferred citizenship rights to Māori (article 3). Discrepancies between the Te Reo Māori text (te Tiriti o Waitangi) signed by over 500 Māori rangatira (chiefs) and the English text, signed by Crown representatives, are the source of substantial, enduring debate. Debate notwithstanding, the Treaty is broadly understood to be a covenant, or Kawenata – an enduring promise to protect Māori interests against the negative impacts of Crown settlement (Paine et al., 2013), including the protection of Māori health (Health Quality and Safety Commission (HQSC), 2019; Kingi, 2006). Inequities between Māori and non-Māori constitute failure of the Crown to meet obligations of both the Treaty and the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (HQSC, 2019; Paine et al., 2013; Reid & Robson, 2007; United Nations, 2007). Equity is defined by the World Health Organisation (WHO) as "the absence of unfair, avoidable or remediable differences among groups of people" (WHO, n.d.); the presence of such differences therefore constitute inequity. The Crown's Treaty violations are evident in different distributions indicating Māori disadvantage across deprivation deciles, income brackets, and occupational classes, all of which contribute to consistent and compelling inequities in health (Howden-Chapman & Wilson, 2000; Ministry of Health, 2018). Māori are over-represented in almost every type of illness and every known determinant of poor heath (HQSC, 2019). These inequities exist across the lifespan and begin in utero; Māori mothers and infants have higher rates of serious adverse perinatal outcomes and mortality (HQSC, 2019; Perinatal and Maternal Mortality Review Committee (PMMRC), 2021). They pertain to mental as well as physical health; suicide, the leading cause of maternal death in NZ, particularly affects wahine Māori (Māori women) and their whānau (PMMRC, 2021).

Inequities between Indigenous and non-Indigenous peoples stem from institutional racism and marginalisation; the long-term sequelae of colonisation (Cram et al., 2006; HQSC, 2019; Hobbs et al., 2019; Reid & Robson, 2007; Smylie, 2005). Institutional racism includes inappropriate action and/or inaction by organisations, structures and systems (e.g., National health, justice and education systems) in response to need, as well as the monocultural perspectives and worldviews informing those institutions (Reid & Robson, 2007). A system designed from a monocultural perspective is often intended to provide equal opportunity for all participants, and those for whom the system works well often assume it works similarly for all others. When unequal outcomes are apparent, Māori disadvantage can often be misattributed to any combination of "inferior genes, intellect, education, aptitude, ability, effort, or luck" (Reid & Robson, 2007, p. 5). This spurious reasoning is consistent with 'deficit theory' or 'victim blame' analysis and it precludes examination of the systemic and structural biases that foster inequity (Reid & Robson, 2007). The NZ Ministry of Health (MOH) acknowledges this issue in its working definition of equity: "In Aotearoa New Zealand, people have differences in health that are not only avoidable but unfair and unjust... Equity recognises different people with different levels of advantage may require different approaches and resources to get equitable outcomes" (Ministry of Health, 2018, p. 5). The current research is situated within this broader rights-based framework.

As Sir Mason Durie explains in his foreword to the 2019 report on Māori health equity, "more than simply acknowledging the Treaty as a founding document, the challenge is to implement the promise of the Treaty by tackling inequities through policies, programmes and services that are proudly biased towards Māori. It is not a matter of favouritism, political correctness or deference to Māori; rather, it is a matter of health and wellbeing and the eradication of inequities" (HQSC, 2019, p. 6). It is essential that such policies, programmes and services are informed by research designed specifically to understand the unique needs of Māori (Paine et al., 2013). These imperatives are further focused on the field of maternal mental health in the latest report by the NZ Perinatal and Maternal Mortality Review Committee (PMMRC, 2021); "PMMRC strongly

recommends making targeted investment in maternal mental health a key priority for funding by the Ministry of Health… Investment should prioritise populations who would benefit the most, such as ngā mama Māori (Māori mothers), and be informed by research findings about when women most need that support" (p.15).

Today, NZ is a nation of approximately 5.4 million people (Stats NZ, 2024). Approximately 16.5% of the population identify as ethnic Māori either alone or in addition to one or more additional groups. Approximately 70.2% of New Zealanders identify as European; 8.1% as Pacific peoples; 15.1% as Asian; 1.5% as Middle Eastern, Latin American, or African; and 1.2% as 'Other' (Stats NZ, 2019b). Self-identified ethnicity, as opposed to race or ancestry, is recommended as the standard for research and discussion across the health and disability sector in NZ (Paine et al., 2013). Stats NZ (2019a) defines ethnicity as "a measure of cultural affiliation and not race, ancestry, nationality, or citizenship. An ethnic group is made up of people who have some or all of the following characteristics:

- A common proper name;
- One or more elements of common culture which need not be specified, but may include religion, customs, or language;
- Unique community of interests, feelings, and actions;
- A shared sense of common origins or ancestry; and
- A common geographic origin."

This definition recognises that ethnicity is self-perceived and can, therefore, change over time, and individuals can belong to more than one ethnic group. Consistent with Kaupapa Māori epidemiological methods (discussed further below), New Zealanders who identify with any ethnic group other than Māori can be classified as non-Māori. The structure of the Māori population is younger than the non-Māori population; 1 in 3 Māori are under 15 years of age (compared with 1 in 6 non-Māori), while only 1 in 17 are aged 65 years and over (compared with 1 in 6 non-Māori;

Stats NZ, 2015). The Māori population is growing, driven primarily by higher birth rate; from 2012-2014 total fertility rate was 2.5 for Māori women compared to 1.9 for non-Māori women (Stats NZ, 2015).

The Research Context

The current research is part of a large project named *Moe Kura: Mother and Child, Sleep and Wellbeing in Aotearoa/New Zealand (Moe Kura). Moe Kura* is 3-year longitudinal study focused on the role of sleep in the health and well-being of mothers and their children in NZ. It evolved from an earlier study *E Moe Māmā: Maternal Sleep and Health in Aotearoa/New Zealand (E Moe Mama)* (see Signal et al., 2022, p. for a summary of E Moe Māmā/Moe Kura findings to date). *Moe Kura* is grounded in Kaupapa Māori research theory; an Indigenous research paradigm that is responsive to Māori needs and committed to providing outcomes that are useful to Māori (Paine et al., 2013; Pihama et al., 2002). Consistent with Crown obligations regarding equity under te Tiriti o Waitangi/the Treaty of Waitangi, this approach promotes the use of a Māori vs. non-Māori analytical framework (Paine et al., 2020; Signal et al., 2022). Fundamental to the framework of *Moe Kura* and the current research embedded within it, is the explicit acknowledgement that "self-identified ethnicity is not a "risk-factor" for poor sleep health, but rather it provides a measure of the "riskiness" that exists for Māori in a racialized settler society" (Signal et al., 2022, p. 286).

1.2 Researcher's Identity and Position

I am a NZ European/Pākehā (non-Māori) woman living without socioeconomic deprivation. My position is one of privilege, and though my intentions are good, there are experiences discussed in this thesis that I will never fully understand – particularly the experience of being Māori in a racialised society. With awareness of my inherent limitations, I am committed to honouring the Kaupapa Māori research principles of *Moe Kura*, and the mothers who devoted their time to this important mahi (work).

I am also a mother. When I began this thesis, my older child was two years old; as I complete it, he is seven, and my younger child is three. Over the course of this research, I have gone through pregnancy and postpartum, and the preschool period twice over. At times this work has felt 'too close to the bone'[1], yet I am grateful for the additional perspective that my personal proximity to the subject matter has provided. Most significantly, my lived experience—though privileged—provided a visceral reminder of the challenges and complexities that characterise the topics of maternal mental health and child sleep. Ultimately, this proximity helped me to approach the research presented in this thesis with greater nuance and empathy.

1.3 Scope of the Thesis

The scope of this thesis is restricted to secondary analysis of data of the mothers and children who were participants in the *Moe Kura* study. The data used in this study were collected from the mothers' third trimester of pregnancy, at 12-weeks postpartum, and when the children were preschoolers (i.e., 3-4 years old).

1.4 Thesis Overview

This thesis has been written in the format of a Doctorate with Publications, with the results presented as two individual research papers. The following chapters introduce the current research with discussion of the relevant background literature. Chapter 2 begins with an overview of sleep and sleep development in early childhood, followed by an introduction to the multidimensional concept of sleep health. The dimensions of paediatric sleep health are explained with reference to international and NZ research. Next, literature on sleep problems in early childhood is explored in all its complexity. Finally, attention returns to sleep health inequity in the

[1] I initially intended to extend my master's research and study sleep and mental health in adolescents but was encouraged to join the *Moe Kura* whānau when the adolescent project was no longer available.

NZ context, and critical research gaps are highlighted. Chapter 3 focuses on PND as one specific socio-ecological factor relevant to paediatric sleep health. An overview of PND is provided, including its aetiology and its consequences for general child development. This is followed by an examination of emerging research exploring relationships between maternal prenatal depression and subsequent offspring sleep across infancy and early childhood. Chapter 3 concludes with a discussion of inconsistences and gaps in the nascent literature and reiterates the combined aims of this thesis. Chapter 4 provides a more detailed overview of the methodology than is afforded by the manuscripts. Chapters 5 and 6 present the research results in the form of the original manuscripts, with references included. The tables are re-labelled from their original numbering to align with the thesis format but are otherwise unchanged. Both manuscripts have been accepted for publication; the first (Chapter 5) is in press with *Sleep Health*, the second (Chapter 6) is in press with *Sleep*. Chapter 7 concludes this thesis with an integration and discussion of the results, situating the thesis within the existing literature and outlining the implications of the findings for research and clinical practice.

CHAPTER 2 SLEEP

Across early childhood, children spend more time in sleep than in wakefulness (Galland et al., 2012; Iglowstein et al., 2003); a finding that gives credence to the words of pioneering sleep researcher Allan Rechtschaffen (1927-2021), "if sleep does not serve an absolutely vital function, it is the biggest mistake the evolutionary process has ever made." Healthy sleep is considered essential for optimal child development, evidenced by its role in numerous key domains, including brain maturation, cognitive and emotional functioning, and physical health (El-Sheikh & Sadeh, 2015). Beyond the individual, child sleep is central to family health and wellbeing (Muller et al., 2019b), and the impact of sleep health reverberates through communities and across time (Meltzer et al., 2021). But what exactly is sleep health? And how is it achieved? This chapter provides an overview of sleep development from physiological and socio-ecological perspectives, followed by a review of the literature on sleep health and sleep problems in early childhood. Special attention is given to research on child sleep in the NZ context, and inequities in child sleep health between Māori and non-Māori.

2.1 Sleep Architecture

Sleep architecture refers to the electrophysiological structure and pattern of sleep, which is typically characterised by alternating cycles of non-rapid eye movement sleep (NREMS) and rapid eye movement sleep (REMS) on the basis of polysomnography that monitors electroencephalographic (EEG) patterns, eye movements, and muscle tone (Amlaner & Fuller, 2009). In the first 6 months after birth, these sleep states are not clearly delineated. Instead, infants exhibit two primary types of sleep: "quiet sleep", a precursor to NREMS sleep, and "active sleep", a precursor to REMS (Jenni & Carskadon, 2009). In newborns, "quiet" and "active" sleep are often disorganised and immature, sometimes referred to as *intermediate* or *transitional* sleep (Jenni & Carskadon, 2009). After 6 months of age, NREM can be subdivided into three stages on the basis of EEG activity. Stage 1 occurs at the transitions of sleep and wakefulness. Stage 2 is

characterised by frequent bursts of rhythmic EEG marked by 'sleep spindles' (first occurring after 4 weeks of age) and high voltage spikes, termed 'K-complexes' (first occurring after 6 months). Stage 3, called slow wave sleep (SWS), is characterised by an EEG pattern of continuous (minimum 20%) high voltage activity in the slowest (< 2 Hz) frequency range. Across the first year, EEG voltage increases substantially, particularly in NREMS (Jenni & Carskadon, 2009). REMS is characterised by high levels of desynchronised EEG activity, absence of muscle tone, and the eponymous, episodic bursts of rapid eye movements. The 'active' sleep of young infants reflects frequent body jerks and muscle twitches that overcome the muscle inhibition of infant REMS (Jenni & Carskadon, 2009).

Stark developmental differences in sleep architecture are seen in the first months and years of life. Newborns enter sleep through 'active sleep', and transition to an adult pattern of entering sleep via NREMS at around 3 months (Jenni & Carskadon, 2009). In early infancy, sleep is divided evenly between NREM and REMS (Jenni & Carskadon, 2009), alternating in cycles of approximately 50 minutes. Across early childhood, the proportion of REMS gradually decreases to the 20-25% proportion seen in older children and adults, and sleep cycle periods gradually increase to the mature period length of approximately 90 – 110 minutes (Jenni & Carskadon, 2009).

2.2 Physiological Basis of Sleep Development

At a physiological level, sleep/wake cycles are regulated by two processes: the circadian time keeping system (process C) and the homeostatic sleep system (process S). These processes function independently of each other and interact to influence sleep timing and duration, together forming the dual-process model of sleep (Borbély, 1982). Process C is an intrinsic mechanism driven by the suprachiasmatic nucleus (SCN) in the hypothalamus and constitutes the 'biological clock'. This 'clock' mechanism oscillates on a near 24-hour cycle that is sensitive to light input for synchronization with the environment. Light is a "zeitgeber", a "time giver" or environmental cue that provides input to the circadian system to help entrain an individual to the 24-hour light/dark

cycle. Other less potent zeitgebers include eating and physical activity (Quante et al., 2019). Process S denotes the sleep pressure system; the process that drives sleep after long periods of wakefulness. In older children and adults, the cycle of process S occurs within a value range that is usually aligned with night and day. Over the course of the day, pressure for sleep increases towards the upper boundary of that value range, ultimately triggering sleep when it is reached. Sleep subsequently reduces this homeostatic pressure, and wakefulness is triggered when the range's lower boundary is ultimately reached (Borbély et al., 2016). In young children, the establishment of this two-process model can be described with reference to two key processes: sleep consolidation and sleep self-regulation.

Sleep consolidation refers to the process by which sleep patterns transition from shorter, polyphasic sleep/wake episodes to longer periods of uninterrupted sleep in an increasingly diurnal pattern. As sleep is consolidated, infants exhibit longer periods of night sleep combined with longer periods of wakefulness during the day. Sleep consolidation is heavily influenced by brain maturation – particularly development of the pineal gland, which secretes nocturnal sleep-supporting melatonin in response to information from the environment on the dark/light cycle (Davis et al., 2004a; El-Sheikh & Sadeh, 2015). In addition to a more established circadian rhythm, sleep consolidation is supported by an infant's developing capacity for sleep self-regulation.

Sleep self-regulation describes an infant's ability to transition from wakefulness to sleep independently at bedtime and following nocturnal or naptime wakings. It is normal for infants and young children to wake between sleep cycles. As sleep self-regulation develops, infants are increasingly able to resume sleep at these transition points, without signalling for caregiver assistance (e.g., by crying or calling out).

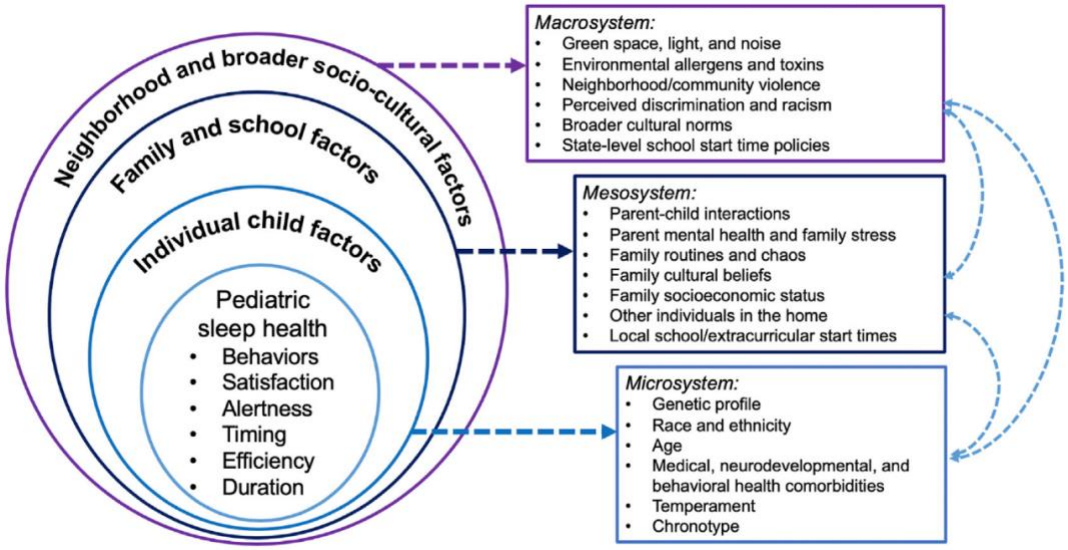
These processes are central to sleep health in infancy and early childhood, and sleep problems are often discussed with reference to their slower-than-expected progression. In addition to

physiological maturation, sleep consolidation and sleep self-regulation are influenced by the dynamic socio-ecological systems in which they occur.

2.3 Socio-Ecological Models of Sleep Development in Early Childhood

More than three decades ago, Sadeh and Anders (1993) proposed a seminal transactional/ecological model of infant sleep illustrating the myriad determinants of sleep development, and their bidirectional relationships. This model acknowledged that infant sleep develops within a complex and dynamic ecosystem. In turn, infant sleep influences parts of that ecosystem, particularly infant health and family functioning. In adults, sleep is commonly conceptualised with the Social Ecological Model of Sleep (Grandner, 2017), which organises sleep health determinants into concentric levels of proximity to the individual. Factors at the individual level (e.g., genetics, health, behaviour), are embedded within a social level (e.g., socio-economics, neighbourhood, race/ethnicity), which in turn exists within a societal context (e.g., technology, public policy, environment). Meltzer et al. (2021) built on the foundations of these respective infant and adult models, to develop a model of sleep health that fit the broad paediatric population (reproduced in Figure 1.1). It outlines factors at different levels of a child's social ecology that are thought to contribute to the dimensions of child sleep health (and problems) independently or interactively. At the microsystem level are characteristics of the individual child, including genetics, temperament, and age. Next, at the level of the mesosystem are factors related to the child's immediate environments at home and school, including parent mental health and family stress, parent-child interactions, and family socioeconomic position (SEP). Finally, at the level of the macrosystem are factors related to the child's neighbourhood and broader socio-cultural factors, such as community violence, environmental light and noise, and environmental allergens and toxins.

Figure 2.1: *Socio-ecological factors hypothesised to contribute to paediatric sleep health domains*



Note. Reprinted from Sleep Medicine Reviews, 57, Meltzer et al. *Paediatric sleep health: It matters, and so does how we define it*, p. 2. Copyright 2021, with permission from Elsevier.

2.4 Sleep Health

The concept of 'sleep health' integrates physiological and socio-ecological understandings of sleep to provide a broad set of sleep concepts that relate sleep to health outcomes (Buysse, 2014). Sleep health is expressed as a positive attribute and framing it in this way emphasises sleep's critical role in overall health. Just as health is more than the absence of disease, the concept of sleep health describes more than the absence of a sleep problem. Sleep health is defined as "a multidimensional pattern of sleep-wakefulness, adapted to individual, social, and environmental demands, that promotes physical and mental well-being. Good sleep health is characterised by subjective satisfaction, appropriate timing, adequate duration, high efficiency, and sustained alertness during waking hours" (Buysse, 2014, p. 12). Research has found these measurable characteristics of sleep to be the ones most clearly associated with physical, mental and neurobehavioral well-being (for a summary, see; Buysse, 2014, p. 12). The acronym SATED captures these key dimensions (Satisfaction, Alertness, Timing, Efficiency and Duration) to facilitate quick, well-rounded sleep health assessment. Buysse's definition of sleep health provides targets for health

promotion and prevention and has important research implications. It provides a meaningful measure by which to characterise populations and identify sleep profiles that might be associated with adverse health outcomes. Buysse (2014) notes that his definition of sleep health is most appropriate for adults (who are relatively autonomous), but that it "could be adapted to infants, children and adolescents" (p.12). In response, Meltzer et al. (2021) conducted a review of paediatric sleep health and proposed a definition that fits the more complex paediatric context. Unlike adults, children have minimal control over the determinants of their sleep health. Instead, their SATED dimensions are largely influenced by the dynamic socio-ecological systems in which they live. Their sleep is also highly influenced by developmental factors, as well as the interaction between developmental and socio-ecological factors. Meltzer et al. (2021) proposed a 6th dimension to form the acronym 'Peds B-SATED', where B denotes Behaviours that are known to be sleep-promoting (e.g., bedtime routines) or inhibiting (e.g., caffeine use). The Peds B-SATED model translates to a revised, child-specific version of Buysse's definition of sleep health (additions italicised): "Good sleep *in paediatrics* is characterised by subjective *or caregiver-rated* satisfaction, appropriate timing, adequate duration *for age*, high efficiency, sustained alertness during waking hours, *and healthy sleep behaviours*" (Meltzer et al., 2021, p. 7).

Dimensions of Child Sleep Health

Sleep health is highly dynamic, never more so than early childhood when developmental changes are marked and frequent. A picture of sleep health at 2 months looks quite different at 4 years, reflecting vastly different stages of development and corresponding needs. This section first aims to define each of the six dimensions of sleep health and situate them in the process of normal sleep development. The roles of the respective dimensions of sleep health in broader child health and wellbeing are outlined through a brief discussion of relevant literature, with particular attention to NZ research. The sleep location domain, a complex research area highly relevant to sleep health and development and worthy of further study, is also explored here.

2.4.1.1 Sleep Timing

Sleep timing is the placement of sleep within the 24-hour day. It is strongly influenced by the physiological process of sleep consolidation, as described above. In newborns, the circadian system is not fully established, and homeostatic sleep pressure builds quickly. This produces polyphasic sleep that occurs as easily during the day as at night (Davis et al., 2004a). Until approximately 3 months of age, infants will typically sleep for 14 to 18 hours a day in 2-4 hour episodes, interspersed with short periods of wakefulness (Davis et al., 2004b; Galland et al., 2012; Sadeh et al., 2009). This sleep/wake pattern serves several key functions. High total sleep duration supports rapid brain development that occurs in the first months of life, and high fragmentation encourages the frequent feeding newborns require for adequate nutrition, given their small stomach capacities and high metabolic rates (Huffman & Martin, 1994). Additionally, newborns have immature thermoregulatory systems, making them more susceptible to changes in environmental temperatures (Fleming et al., 1992). Polyphasic sleep gives caregivers more opportunities to respond to changes in temperature that could otherwise put infants at risk of hypothermia or overheating (Bach & Libert, 2021). In addition to survival, these numerous opportunities for caregiver-child interactions may also foster early attachment (D'Souza & Cassels, 2023). Finally, frequent wakings are also thought to support the responsiveness of infant arousal mechanisms, potentially helping to protect against sleep-related infant death (Baddock et al., 2019). At around 10-12 weeks the circadian rhythm that drives sleep and wakefulness begins to emerge, and homeostatic sleep pressure starts to rise more slowly. Gradually, infants can obtain longer periods of wakefulness, and as sleep/wake cues of hunger and satiety are replaced with circadian cues for light and dark, sleep becomes increasingly nocturnal (Galland et al., 2012).

As children develop, other sleep-timing factors emerge as important for their health and wellbeing. Early bedtimes, for example, are associated with longer sleep duration and long-term health benefits. One study indicates preschool aged children with early weekday bedtimes (8pm or earlier) are half as likely as children with late bedtimes to be obese as adolescents (Anderson

et al., 2016). The term 'social jetlag' describes the discrepancy between our biological and social clocks, usually measured as the weekend-to-week day difference in midsleep time (Doi et al., 2015). Most research on social jetlag has been done with adults and adolescents, however emerging evidence suggests it is also an important component of the sleep health and broader wellbeing of young children. A study investigating sleep timing and duration in 2 to 4-year-old children with obesity from low-income families found that social jetlag was associated with increased caloric intake, particularly from fats (Petrov et al., 2017). Social jetlag has also been associated with behavioural problems in children aged 4-6 years (Doi et al., 2015).

The demands of work and family can present substantial challenges to optimal sleep timing for children. For many families, life circumstances (including parental and childcare schedules) and/or family values are considered to be incompatible with consistent, early bedtimes. Galland and Elder (2021) argue that it is important to consider the influence of these factors on family sleep practices, for instance considering whether late work hours and values related to family togetherness can combine to push bedtimes later. Undoubtably, families are complex entities and parents are often juggling the conflicting needs of multiple children. The activities of older siblings in the evening or during nap periods can also impact the timing of young children's sleep (Meltzer et al., 2021). Culture is also relevant to sleep timing. In Mediterranean and equatorial cultures, for example, an afternoon siesta or rest period is common and evening meal and bedtimes are often relatively late (Buysse, 2014).

Sleep timing in NZ

The NZ MOH recommends that preschool-aged children have consistent bed- and wake times, with bedtimes no later than 8pm (Ministry of Health, 2017). The landmark cohort study, Growing Up in New Zealand (GUiNZ), indicates that the average bedtimes for NZ preschoolers are within these guidelines (7:53pm and 7:45pm for 3 and 4 year olds, respectively), and that the vast

majority of 4 year olds (91%, *n* = 5,973) go to sleep at the same time each night (Morton et al., 2017).

2.4.1.2 Sleep Efficiency and Continuity

Key indices of sleep self-regulation, sleep efficiency and continuity pertain to the ease with which a child can fall asleep, remain asleep, and return to sleep after waking (Goodlin-Jones et al., 2001). Sleep efficiency describes the ratio of sleep time to time in bed (El-Sheikh & Sadeh, 2015). It therefore accounts for time to fall asleep, as measured from the intended sleep time (sleep onset latency; SOL), as well as periods of nighttime wakefulness, after sleep was initiated (wake after sleep onset; WASO). The related concept of sleep continuity describes sleep that is maintained without signalled wakings.

The distinction between signalled and non-signalled wakings is important in the child sleep literature. As discussed above, brief wakings at the transition points between sleep stages is developmentally normal in infancy and early childhood. Therefore, non-signalled wakings are generally not reflective of poor sleep development or sleep health (Goodlin-Jones et al., 2001), nor generally do they impact a parent's experience of their infant's sleep. As Meltzer et al. (2021) explain, "although two infants each may wake briefly and return to sleep quickly, it is qualitatively different when the first one returns to sleep independently, compared to the second infant who cries, and parents respond to help the infant return to sleep" (p. 4). To address the meaningful difference between signalled and non-signalled waking, Henderson et al. (2011) proposed differentiating between longest sustained sleep period (LSP) and the longest self-regulated sleep period (LSRSP). The former is an infant's physiological capacity for continuous sleep, and its measurement relies on objective techniques such as polysomnography (a multi-parametric sleep test that includes brain-wave measurement) or videosomnography (a video-based measure). It may also be indicated with actigraphy (a small wearable sensor that measures sleep through activity and light) but is usually not detectable with the parent-report measures that characterise

most of the research in this field. The LSRSP includes the LSP together with brief periods of non-signalled wakefulness, followed by the independent resumption of sleep. The LSRSP increases as a function of sleep self-regulation to produce more efficient and continuous sleep. Because LSRSP measures continuous sleep, as experienced by the caregiver, it can be measured with common parent-report measures of child sleep. Henceforth, the term 'night waking' in this thesis refers specifically to signalled wakings.

Night waking reduces with age from birth to 2-3 years (Galland et al., 2012; Mindell et al., 2010), though meta-analysis shows night waking is the most variable characteristic of early childhood sleep (Galland et al., 2012). On average, the number of night wakings reduces from 1.7 at 0-2 months, to 0.8 at 3-6 months, and 0.7 at 1-2 years (Galland et al., 2012). Corresponding changes are seen in LSRSP, with the most rapid increase in LSRSP occurring between 1 and 4 months (Henderson et al., 2011). Meta-analyses show infants exhibit a mean LSRSP increase from a range of 4.6 – 5.6h at age 1 month, to 5.5 – 8.8h at 2 months, and beyond 7 hr at 3 months (7.1 hr – 10.5 hr), and 4 months (7.1 hr – 11.4 hr) (Henderson et al., 2011). Average LSRSP increases at a slower rate after 4 months. By 12 months, many infants can self-regulate sleep for over 9 hours, and the mean LSRSP at 12 months is estimated at 10.3 hr (Henderson et al., 2011). It is important to note that, despite these broad developmental trajectories, children vary widely in their capacity for sleep self-regulation, as reflected in wide ranging data on continuity and efficiency observed across infancy and early childhood (Galland et al., 2012; Jenni & Carskadon, 2012).

While research shows the development of sleep self-regulation is positively associated with sleep efficiency and continuity, a key dimension of sleep health (Goodlin-Jones et al., 2001; Meltzer et al., 2021), there is no consensus in the literature on whether this dimension reflects sleep health at all ages. Some argue high sleep efficiency is an erroneous objective in infancy, that no studies to date have linked early self-soothing to later independence, and that "sooner the better" assumptions regarding self-regulation are actually harmful to children (Barry, 2021a, 2021b). Indeed, the topic of sleep self-regulation, including developmental appropriateness, is frequently

debated in the literature as well as among clinicians and parents. This topic is discussed further in section 2.4 on sleep problems. Acknowledging that some night waking is normal throughout early childhood (i.e., prior to age 5 years), NSF and MOH guidelines state that, for toddlers and preschoolers, waking once or less per night is 'appropriate', waking twice is of 'uncertain' appropriateness, and waking three or more times is 'not appropriate' (Hirshkowitz et al., 2015; Ministry of Health, 2017).

Sleep efficiency and continuity in NZ

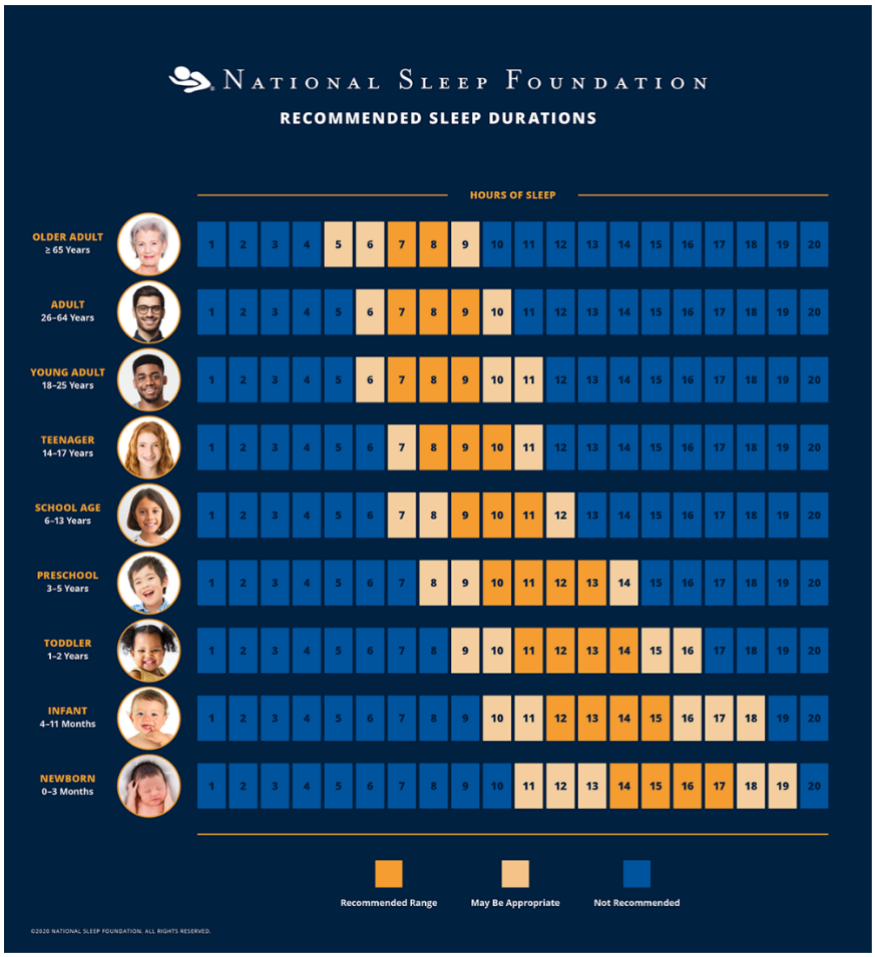
In NZ, the high variability in child sleep efficiency and continuity is well captured in research from the GUiNZ study. In data collected on 6-week-old infants (n = 6,843), parents reported LSRSPs ranging from 30 minutes to over 13 hours (Morton et al., 2012). At age two years (n = 6,308), continuous nighttime sleep (i.e., no night wakings) was reported for approximately half the cohort (51%). Approximately one third of toddlers woke once per night (32%), and 12% woke twice. A further 5% of toddlers woke three or more times per night (Muller, Signal, et al., 2020). As preschoolers (n = 6,186), most of the cohort exhibited continuous night sleep (62%), though some night waking remained common; 30% regularly woke once per night, 6% woke twice, and 1.5% woke three or more times (Muller, Signal, et al., 2020).

2.4.1.3 Sleep Duration

For many, the concept of sleep health centres on the notion of getting 'enough' sleep. This is the domain of sleep duration: the total amount of sleep obtained per 24 hr. Reflecting its pertinence, sleep duration is the focus of much paediatric sleep research, and there are clear recommendations for optimal sleep duration across development. Figure 1.2 displays the age-based optimal ranges for sleep duration, according to the National Sleep Foundation (NSF; Hirshkowitz et al., 2015). Each range is strikingly broad - particularly the early childhood bands, and the recommendations change with relatively small age increments. The NSF report states optimal sleep duration per 24 hours (including naps) are 14-17 hours for newborns, 12-15 hours

for infants, 11-14 hours for toddlers, and 10-13 hours for preschoolers (Hirshkowitz et al., 2015). Notably, the NSF report acknowledges the paucity of evidence linking sleep duration to health outcomes in infants, particularly in newborns. In a subsequent and widely accepted consensus statement from the American Academy of Sleep Medicine (AASM) on paediatric sleep duration, recommendations for infants younger than 4 months are omitted entirely on this basis (Paruthi et al., 2016). After 4 months of age, recommendations from the AASM are in line with the NSF.

Figure 2.2: *National Sleep Foundation duration recommendations across the lifespan*



Note. Reprinted with permission from National Sleep Foundation (2020), personal communication, 8 Nov 2024.

These recommended durations are considered 'optimal' because they are associated with better child health outcomes in numerous domains, including mental and physical health, attention, memory, learning, behaviour, emotion regulation, and quality of life (Meltzer et al., 2021; Paruthi

et al., 2016). Conversely, children regularly attaining shorter-than-recommended sleep are at risk of numerous health difficulties, including problems with attention, learning, and behaviour, as well as increased risk for accidents, injuries, hypertension, diabetes, and depression (Paruthi et al., 2016). Longer-than-recommended sleep is also considered suboptimal; regular sleep durations above recommended range is associated with many of the same physical and mental health problems as short sleep (Paruthi et al., 2016). Several studies illustrate the curvilinear relationship between sleep duration and paediatric health outcomes, particularly with regards to poorer cognitive and behavioural functioning among children who regularly attain sleep durations above or below the optimal range (El-Sheikh et al., 2019; James & Hale, 2017).

Though the NSF and AASM recommendations are instructive, they are also limited. Evidence informing the recommendations was not published in a review, therefore the studies on which the guidelines are based cannot be evaluated. Many contributing studies may measure obtained sleep, which can reflect sleep opportunity, rather than sleep need. Studies measuring obtained sleep will inherently be influenced by characteristics of the participant group that are not necessarily generalisable to the needs of all children. For example, research has found differences of up to 1.5 hours in the sleep duration of young children in countries such as Korea and Japan compared to the United Kingdom and NZ (Mindell et al., 2010). It is currently unclear whether such differences are a consequence of differences in cultural practice or biological need, or some complex interplay between these and other factors. Indeed, no controlled studies have investigated sleep need in young children (Meltzer et al., 2021); addressing this research gap would allow for more precise recommendations for sleep duration in early childhood.

Sleep duration in NZ

NZ MOH sleep duration guidelines are consistent with the NSF recommendations (Ministry of Health, 2017). In the GUiNZ cohort study (Muller, Signal, et al., 2020), toddlers (age 24 months; *n* = 6,308) slept for an average of 10.6 hours overnight and 1.8 hours during the day. Average total

sleep duration over 24 hours was 12.4 hours, and 17% of the children did not meet the recommended 11-14 hours of sleep over this period. Preschool children (age 45 months; *n* = 6,186) slept for an average of 10.7 hours overnight. A little over a third of the four-year-olds took regular daytime naps (35%), with an average nap duration of 1 hour 30 minutes, and an average 24-hour total sleep duration of 11.2 hours. For more than 90% of preschoolers in the GUiNZ study, reported sleep durations fell within the recommended 10-13 hours.

2.4.1.4 Sleep-Related Behaviours

Sleep-related behaviours are actions or activities that may promote or inhibit child sleep health. Meltzer et al. (2021) added this paediatric-specific dimension to Buysse's original model. It encompasses sleep regularity, which Buysse (2014) identified as an additional dimension important for treatment of sleep difficulties but less clearly associated with health outcomes. In the paediatric context, regularity translates to consistent sleep schedules and routines. This regularity can be applied to many of the core dimensions of sleep health, but its importance can be seen most clearly with the dimensions of Timing and Duration; regular, early bedtimes encourage sufficient duration. A consistent bedtime (i.e., a regularly enforced time in the evening when the child goes to bed) appears to be particularly important in early childhood. Kelly et al. (2013) found a longitudinal association between consistent bedtimes in preschoolers and key markers of cognitive performance four years later. Specifically, non-regular bedtimes at age 3 years were independently associated with lower scores in reading, maths, and spatial ability at age 7 years. From 5 years, the associations with cognitive performance at 7 years remained only for reading in boys and maths for girls, suggesting possible sensitive period effects in the preschool age (Kelly et al., 2013). Data were not collected prior to age 3 years, so the long-term importance of regular bedtimes for younger children could not be assessed.

Distinct from the concept of consistent bed*time* is a regular bedtime *routine*. The bedtime routine is defined as "the predictable activities that occur in the hour or so before lights out, and before

the child falls asleep" (Mindell & Williamson, 2018, p. 94). The content of bedtime routines can vary across cultures (Hale et al., 2009; Mindell et al., 2010; Mindell et al., 2009; Mindell & Williamson, 2018), and routines can be considered adaptive (e.g., brushing teeth, bathing, reading a story) or maladaptive (e.g., screen-time, high-activity play; (Allen et al., 2016; Henderson & Jordan, 2010). Cross-cultural research on infants and toddlers in 17 different countries or regions shows that bedtime routines share some relatively universal elements (Mindell & Williamson, 2018). Feeding (breast or bottle), for example, featured in the bedtime routine of 73% of all respondents. Other activities were commonly reported in some countries but rarely in others. Interestingly, reading at bedtime was most reported by NZ participants (59%) and least reported by participants in Vietnam (5%) (Mindell & Williamson, 2018). A regular, adaptive bedtime routine has been found to benefit sleep and reduce sleep problems in both clinical and community samples of young children (Jodi A. Mindell et al., 2017; Mindell et al., 2009; Mindell & Williamson, 2018; Staples et al., 2015). In addition to promoting sleep health, adaptive bedtime routines are associated with broader health outcomes as the component activities support different health objectives. Bathing and teeth brushing support good hygiene and physical health; communicative activities such as reading and singing support language, literacy and cognitive development; and physical contact such as massage, cuddling and rocking is thought to promote positive mood, emotion-behaviour regulation and parent-child attachment (Mindell & Williamson, 2018).

The Behaviour dimension of sleep health also includes sleep-inhibiting factors such as caffeine consumption and technology use before bed (Meltzer et al., 2021). Caffeine is a stimulant that can have a physiological impact on sleep onset and continuity. Despite recommendations that children should consume no- or limited caffeine (Ministry of Health, 2012a) studies from the U.S. estimate 28-58% of preschoolers consume caffeine regularly (Ahluwalia & Herrick, 2015; Ahluwalia et al., 2014). The use of visual media, particularly in the hour preceding bedtime, is an established risk factor for poor sleep (Allen et al., 2016), and one that is increasingly relevant to young children. One study found that 39.6% of 1-3 year olds and 65.5% of 3-5 year olds used a tech device before

bed, while 25.0% of 1-3 year olds and 36.1% of 3-5 year olds had a TV in their bedroom (Brambilla et al., 2017).

Sleep-related behaviours in NZ

In NZ, bedtime routines emerged as an important theme in qualitative research conducted with a subset of the Moe Kura participants on sleep health in preschoolers (Muller et al., 2019c). Mothers described consistent and calm bedtime routines as sleep promoting, and disruption or delays to such routines as sleep disrupting. Socioeconomic factors such as financial resources, parent work schedules, and early childhood education environments were discussed as important influencers of parents' ability to facilitate sleep regularity in their preschoolers' sleep (Muller et al., 2019c). With regards to sleep-inhibiting behaviours, caffeine consumption rates among preschoolers in NZ appear to be at similarly high levels to the U.S. (Thomson & Schiess, 2010), and GUiNZ data links visual media use to shorter sleep duration and more night wakings (Muller, Signal, et al., 2020). The MOH recommended daily screen time does not exceed 1 hour for preschoolers, a target achieved by approximately 54% of NZ four-year-olds (Morton et al., 2017).

2.4.1.5 Alertness/Sleepiness

Alertness and sleepiness, respectively, describe the ability or difficulty to maintain attentive wakefulness. In older children and adults, good functioning in this domain is marked by sleep successfully dissipating sleep pressure, bringing corresponding feelings of alertness throughout most of the day, and sleepiness at bedtime; a pattern that is important for optimal daytime functioning and general wellbeing (Iglowstein et al., 2003; Jenni & Carskadon, 2012; Jenni & LeBourgeois, 2006). During infancy and early childhood, however, expectations around alertness and sleepiness are quite different and shift with changes in sleep consolidation, as described in section 2.2. For example, napping results from the relatively rapid build-up of sleep pressure during infancy and early childhood and is considered developmentally appropriate (Jenni & LeBourgeois, 2006). Napping in early childhood is important for optimal social and emotional

functioning. The presence, number and timing of naps is driven by several factors. As sleep pressure builds more slowly, the biological drive to nap is reduced (Jenni & LeBourgeois, 2006). Napping appears to be essential for obtaining sufficient sleep in the first two years of life, with similar patterns observed across different populations (Mindell et al., 2013; Staton et al., 2020). However, beyond age 2-3 years, napping appears to be associated with reduced night sleep and thus a redistribution of 24-hour sleep timing (Thorpe et al., 2015). From age 3-years, large differences in napping behaviour are seen across ethnicities and cultures. *Moe Kura* data shows that Māori children are less likely to have stopped napping completely by 3-4 years, compared with non-Māori children (Muller et al., 2019a). Similarly, one U.S. study found Black children were more likely than non-Latinx White American children to continue napping beyond age 5 years (Crosby et al., 2005). Looking cross-culturally, it is relatively common for children in predominantly Asian countries/regions to continue to nap until ages 5 and 6 years, whereas most children of the same age have stopped napping completely in predominantly Caucasian countries (Mindell et al., 2013).

Many children transition from a napping to non-napping schedule naturally, as a function of sleep consolidation. However, nap cessation is also driven by socio-ecological factors. An early study estimated one third of toddlers and preschoolers cease napping sooner than they might otherwise in order to align with the schedules of their families or childcare centres (Weissbluth, 1995). This active promotion of night-time sleep consolidation can have advantages and disadvantages for children and their families. One study that used dim light melatonin-onset assessment and actigraphy to measure sleep and circadian parameters in napping versus non-napping toddlers found that the groups had similar 24-hour sleep duration, but that the napping toddlers had later bedtimes, later sleep onset times, and more delayed circadian phases (Akacem et al., 2015). Another study found that the transition to a full-day, no-nap early childcare education centre (ECE) was associated with earlier nighttime sleep timing and fewer parent reports of bedtime difficulties (Cairns & Harsh, 2014). Disadvantages to enforced nap cessation are seen among

children who are not developmentally ready for consolidated nighttime sleep and struggle to bear the increased homeostatic load. These children can experience daytime sleepiness, poorer daytime functioning, and impaired emotion and self-regulation (Berger et al., 2012; Dahl, 1996; Miller et al., 2015). The biologically optimal time to stop napping is likely highly influenced by children's individual differences and is therefore hard to define. The need to explore different approaches for phasing out naps that simultaneously retain emotional and cognitive performance and minimise bedtime settling difficulties is a recognised challenge in the field of paediatric sleep health (Akacem et al., 2015).

Alertness/sleepiness in NZ

In NZ, these complex dynamics are reflected in qualitative research within *Moe Kura*, where mothers discussed the importance of home-ECE congruence regarding napping (Muller et al., 2019c). Many participants raised issues with their ECE napping policies not fitting their child's developmental stage or home routine. Specifically, compulsory napping appeared to cause bedtime difficulties that increased household stress without increasing the child's total sleep duration. Conversely, nap routines that were consistent across ECE and home environments supported sleep regularity (Muller et al., 2019c).

2.4.1.6 Sleep Satisfaction/Quality

Inherently difficult to quantify, the dimension of sleep satisfaction/quality aims to capture the subjective experience of "good" or "poor" sleep. Where the other dimensions of sleep health can be measured with behavioural or physiological data, sleep satisfaction/quality is, by definition, subjective (Buysse, 2014). Adults, adolescents and older children can provide self-reported interpretations of their sleep. Two individuals could have identical sleep in all other dimensions, but one could rate their sleep as "poor", the other "good". These subjective ratings often correlate poorly with more objective measures and are influenced by expectations and beliefs as well as environmental and social contexts (Kaplan et al., 2017; Meltzer et al., 2021). Data on infant or

preschooler sleep satisfaction/quality relies on parent report, which research shows is influenced by parents' perception of their own sleep quality. Rönnlund et al. (2016) found that with children aged 2-6 years, parental sleep problems were associated with more frequent reporting of child sleep problems. This association was not explained by the more objective actigraphy measures of the children's sleep, nor, interestingly, by parental mental health variables.

The difficulty of measuring sleep satisfaction/quality in young people does not discount its importance. A meta-analysis of relationship between sleep and depression in adolescents shows that adolescents diagnosed with depression report reduced sleep quality (Lovato & Gradisar, 2014). Although more difficult to quantify, subjective perceptions of sleep satisfaction/quality remain relevant in young children and should be captured as accurately as possible. The presence of absence of a parent-perceived sleep problem is an imperfect measure of satisfaction/quality often used for infants and young children (Covington et al., 2021). Parent-perceived sleep problems are discussed in section 2.5.

2.4.1.7 Sleep Location

It is well established that sleep location plays a significant role in sleep health and development in early childhood, and yet location receives little attention in the models described above. Sleep location encompasses where a child sleeps in terms of both sleep surface (e.g., cot, bed-sharing with parents) and room (e.g., own bedroom, parent room, shared sibling bedroom). Much of the literature on sleep location comes from research efforts to understand and address sleep-related infant death (e.g., sudden infant death syndrome; SIDS). The American Academy of Paediatrics (AAP) and NZ MOH both recommend infants sleep in the parent bedroom, on a separate sleep surface (e.g., cot/bassinet, or co-sleeper such as a Pēpi-Pod/wahakura); a practice described in the literature as 'room-sharing'. Room-sharing is recommended for at least the first 6 months of life, over both bed-sharing (where the infant shares the parent/caregiver sleep surface) and independent sleep (where the infant sleeps in their own room, usually in a cot or bassinet)

(Ministry of Health, 2022; Moon et al., 2022). Bed-sharing is discouraged due to an established, increased risk of death from SIDS and sleep related suffocation, asphyxia and entrapment (Moon et al., 2022). Bed-sharing in the context of pre- or postnatal tobacco smoke is known to be especially dangerous (McGarvey et al., 2006; Moon et al., 2022).

Despite these recommendations, bedsharing is considered normal and adaptive in many communities worldwide (Morelli et al., 1992), and is an increasingly common practice returning to Western culture (Nelson & Taylor, 2001). In the U.S., the prevalence of parent-infant bedsharing increased from around 6% in 1993 to 24% in 2015 (Bombard et al., 2018), with rates in the U.S. particularly high amongst groups of lower socio-economic position (SEP; Lahr et al., 2007). Studies from England and Sweden also show an increasing trend towards bedsharing, though notably, these rates show no association with SEP (Blair & Ball, 2004; Wennergren et al., 2021).

Beyond safety concerns, bedsharing is often discouraged on the grounds that it does not support optimal sleep health for children or caregivers. Some authors argue bedsharing, and even room-sharing, can interfere with child sleep development by fostering a dependency on parental presence for sleep initiation and maintenance that precludes sleep self-regulation (Henderson et al., 2020; Paul et al., 2017). Indeed, several studies link bedsharing to less consolidated infant sleep, marked by more night wakings and shorter LSRSPs (Henderson et al., 2020; J. A. Mindell et al., 2017; Sadeh et al., 2009). Proponents of bedsharing do not dispute the associations between bedsharing and less consolidated sleep but argue that the overevaluation of sleep consolidation can be harmful for infants and their parents, particularly if it comes at the expense of important developmental processes such as attachment and sustained breastfeeding (Barry, 2021a).

Independent infant sleep (i.e., sleep in a cot or bassinet in the infant's own room) is not recommended in the first 6 months of an infant's life, in part because the more frequent arousals that 'interfere' with infant sleep consolidation are thought to help protect against SIDS (Moon & Task Force On Sudden Infant Death Syndrom, 2016), and because independent infant sleep is

associated with lower rates of sustained breastfeeding (Baddock et al., 2019; Barry, 2021a; Wennergren et al., 2021). Thus, the recommended practice of room-sharing (without bedsharing) can be considered a sleep location 'happy medium' in that it is intended to minimise risk for SIDS risks while maintaining sufficient mother-infant proximity to support breastfeeding and attachment (Moon & Task Force On Sudden Infant Death Syndrom, 2016). However, contention within the literature persists, even in the supposed 'middle ground'. Some experts argue that current recommendations are over-reliant on assumptions that room-sharing will be practiced strictly as intended, thereby inadvertently compromising both safety and sleep development. A large study found that, compared to independent sleepers, infants who room-shared with parent(s) exhibited less consolidated sleep and were at greater risk of overnight transitions to bedsharing, against recommendations (Paul et al., 2017).

Sleep location in NZ

NZ rates of bedsharing are among the lowest in the world (Mindell et al., 2010; Nelson & Taylor, 2001), perhaps as a result of strong local SIDS prevention campaigns and Māori-led initiatives to support safe and culturally responsive sleep practices (Mitchell et al., 1997; Tipene-Leach & Abel, 2019). Specifically, the development of wahakura and Pēpi-Pods, bassinet-like sleep devices designed for on-bed use, have provided safe alternatives to sharing the same sleep surface (Tipene-Leach & Abel, 2019). A randomized controlled trial found wahakura were equally as safe as bassinets, and had additional advantages, such as higher rates of sustained breastfeeding (Baddock et al., 2017).

The largest study on infant sleep location in NZ comes from the GUiNZ project. At 6 weeks of age, most of the infant cohort (n = 6,184) were room-sharing, as recommended; 67% in a cot or bassinet, and a further 5% were using a wahakura or similar on-bed device. Almost one quarter (24%) were sleeping independently, and just 3% were bedsharing (Morton et al., 2012). As preschoolers (n = 3,130), most of the cohort were sleeping independently (64%), 28% were in

their own bed, room-sharing with sibling(s) or other children, 5% were bedsharing with parents, and 2% were room-sharing with parents (Morton et al., 2017).

2.5 Sleep Problems in Infancy and Early Childhood

Given the wide range in normal variation in sleep characteristics and multidimensional nature of sleep health, defining "normal" and "problem" sleep in early childhood is a complex endeavour. Across early childhood, sleep problems are often characterised by sleep that is not sufficiently consolidated and/or self-regulated (Blunden et al., 2011; Hayes et al., 2001; Hunsley & Thoman, 2002; Mindell et al., 2022). Yet as discussed throughout this chapter, wide variability in these processes is normal, and so children can be likely not to meet 'sleep problem' criteria, depending on its characterisation. Indeed, an estimated one third to one half of parents report their infants' sleep is problematic (Bayer et al., 2007; J. A. Mindell et al., 2017; Sadeh et al., 2011). Not surprisingly, there is contention in the paediatric sleep literature on how sleep problems should be defined and operationalised, particularly for infants. As children mature, the parameters of normal sleep become narrower and thus sleep problems are more identifiable in preschoolers. This change is reflected in more specific recommendations for preschooler versus infant sleep. For example (and as discussed in section 2.4.1), the NSF states that preschoolers should attain 10-13 hours of sleep per 24 hours, and that waking once or less per night is 'appropriate', waking twice is of 'uncertain' appropriateness, and waking three or more times is 'not appropriate' (Ohayon et al., 2017). Well-established parent-report measures can help in identifying sleep problems in preschoolers and older children, such as the Children's Sleep Habits Questionnaire (CSHQ). Still, the parameters of normal preschooler sleep are broad, and parent expectations remain an important factor.

Debate in the literature reflects the varying perspectives on what constitutes a sleep problem in society more broadly. A particular pattern of infant sleep that is highly distressing for one parent or family might be inconsequential to another, and both perceptions might differ again from those

of medical and public health specialists, and from researchers (Bayer et al., 2007; Galland et al., 2012). Cultural and family context, including parent expectations, resources, beliefs, and values can all influence whether a particular pattern of sleep is considered a problem (Barry, 2021b; Giannotti & Cortesi, 2009). For example, in many cultures and families where bedsharing is the norm and interdependence is valued over autonomy, night waking is not considered problematic (Baddock, 2010; Ball, 2013). Moreover, and discussed with regards to *Sleep Location*, some researchers argue night waking is beneficial to infant health and development, including via reductions in SIDS-related risks (Bartick et al., 2018; McKenna & McDade, 2005), optimal nutrition and subsequent neurological development (Jing et al., 2010), and enhanced parent-infant synchrony (Baddock et al., 2019; Thomas & Burr, 2002).

What most researchers and experts can agree on is that parents of young children often struggle with child-driven sleep disturbance, and that this is most pronounced when there is conflict between the demands of contemporary lifestyles, parental sleep needs, and infant biology (Ball, 2013; Meltzer & Montgomery-Downs, 2011). As indicated in the socio-ecological models of child sleep (Meltzer et al., 2021; Sadeh & Anders, 1993), the impact of infant sleep patterns reverberates through the family such that even patterns that are developmentally typical can be perceived as 'problematic' by parents who experience corresponding sleep fragmentation and deprivation. Studies show parents' sleep patterns are related to their children's sleep patterns across childhood (Boergers et al., 2007; Meltzer & Mindell, 2007), and particularly during infancy (Gay et al., 2004).

To support families, clinicians have historically been told that while it is important to ensure that parents do not have unrealistic expectations of their child's sleep behaviours, it is parents who are best placed to define whether their child's sleep is problematic. In their clinical article on common paediatric sleep problems, Davis et al. (2004b) argue that "sleep patterns that are simply variations of normal can constitute a real problem when the family's routines are disrupted", and therefore "treatment of most sleep problems is a good idea and worthwhile even if the sleep

pattern that is deemed a problem by the parent is essentially normal and not causing any medical dysfunction" (p. 131). Accordingly, research has sought to understand what defines problematic infant sleep from the perspective of parents. In one such study, Bayer et al. (2007) explored the sleep characteristics associated with parent-identified sleep problems in 3-month-old infants. Frequent night waking was identified as an important predictor of perceived problem sleep, as were breastfeeding the infant to sleep at the beginning of the night, the infant sleeping in the parent's room, and parental disagreement regarding how the infant's sleep should be managed. Findings from Bayer et al. (2007) are consistent with those of numerous other studies that identify night wakings as the main factor by which parents characterise problematic infant, toddler, and preschooler sleep (Galland et al., 2012; Palmstierna et al., 2008). Yet as discussed with regards to *Sleep Efficiency and Continuity*, night waking remains common and is considered appropriate throughout early childhood and is exhibited by more than one half of toddlers and one third of NZ preschoolers (Muller, Signal, et al., 2020). Importantly, a large majority of research on child sleep problems has been conducted from a Western perspective and is predicated on the assumption held by many medical and psychological researchers that more consolidated sleep as early as possible is better for children (Davis et al., 2004b; Henderson et al., 2011; Henderson et al., 2013; Price et al., 2012; Sadeh et al., 2016).

From an alternate perspective, some scholars argue that perceived problems should be addressed by targeting the perceptions, i.e., parent expectations, rather than 'normative' infant sleep behaviours. As part of this effort, Barry (2021b) advocates for a more multidisciplinary approach to infant sleep health; one that integrates findings from psychology and paediatric medicine with anthropology and sociology, essentially because "human culture and behavioural practice changes much more quickly than evolved human biology" (Barry, 2021b, p. 651). Similarly, Ball (2013) argues that parental distress around infant sleep can be exacerbated by misconceptions of normal infant sleep development that create discrepancies between expectations and reality,

causing parents to doubt their competence and seek medical intervention for normative behaviours perceived as sleep problems (Loutzenhiser et al., 2011).

More research is needed to better understand what is 'normal' versus 'problem' infant sleep, and whether it is more appropriate to target sleep behaviours or parent expectations in the NZ context. An important first step is to provide a comprehensive description of infant sleep characteristics, in terms of behaviour and location, and the variables that characterise perceived infant sleep problems currently. Given the between-country differences in child sleep patterns shown in earlier studies (Meltzer et al., 2021; Mindell et al., 2013; Mindell et al., 2010; Sadeh et al., 2011), it is important that any local initiatives are informed by local data. Furthermore, under te Tiriti o Waitangi/the Treaty of Waitangi, Māori have rights to the highest quality research (and data) to inform our health planning. Analysing Māori and non-Māori data separately facilitates understanding and responsivity to the unique needs of Māori.

2.6 Sleep Health Equity in Aotearoa New Zealand

Armed with a broad understanding of sleep health and sleep problems in early childhood, it is critical to discuss their inequitable distributions by ethnicity in the NZ context. For example, although average sleep durations for both Māori and non-Māori preschoolers are in line with recommendations, one in five Māori preschoolers' sleep duration falls outside the recommended 10–13-hour range, compared to non-Māori preschoolers (Muller et al., 2019a). Māori children are more than twice as likely as non-Māori children to have a bedtime later than the MOH recommended 8pm during the week, almost three times as likely to have a bedtime later than 9pm on weekends, and three times as likely to exhibit social jetlag (Muller, Paine, et al., 2020). Additionally, problems falling asleep are more commonly reported for Māori than non-Māori preschoolers (Muller, Paine, et al., 2020).

As discussed in Chapter 1, Māori children are more likely to experience socioeconomic deprivation and poor health outcomes, which reflects their inequitable access to social and health systems and the persistent forces of marginalisation and discrimination resulting from colonisation (Atkinson et al., 2014; Muller, Paine, et al., 2022; Reid et al., 2019). Importantly, many associations seen between ethnicity and sleep problems are independent of socioeconomic position (Muller, Paine, et al., 2020). Direct and vicarious experiences of racism (via a parent or caregiver) are likely to contribute to sleep difficulties in children (Muller, Paine, et al., 2020). This idea is supported by studies exploring the relationships between sleep and racism in Indigenous and ethnic/racial minority children in Australia and the U.S. (Cave et al., 2019; Heard-Garris et al., 2018; Shepherd et al., 2017). NZ sleep health inequities persist through adolescence and into adulthood (Muller et al., 2024; Paine et al., 2004; Paine et al., 2016), but because no large-scale studies have compared the sleep characteristics of Māori and non-Māori NZ infants, it is not yet known when these inequities emerge. Further research on the sleep characteristics of Māori and non-Māori infants is needed.

CHAPTER 3 PERINATAL DEPRESSION

The perinatal period, a time of major life transition, can be a vulnerable time for women. During the perinatal period (pregnancy and postpartum), women are at increased risk for the development or recurrence of mental health disorders, with PND among the most common. PND is characterised by a depressive episode within the perinatal period, with symptoms that mirror those of a major depressive episode (MDE), including depressed mood or anhedonia (loss of interest or pleasure in most previously enjoyed activities), altered sleep or appetite, low energy, and poor concentration (Meltzer-Brody & Rubinow, 2021). In the Diagnostic and Statistical Manual for Mental Disorders, 5th Edition (DSM-5; American Psychiatric Association, 2013), PND is classified as a specifier of depressive disorders, intended to capture MDEs that onset during pregnancy (prenatal depression) or in the four weeks following childbirth (postnatal depression).

Diagnosis of PND requires the presence of either depressed mood or anhedonia, as well as at least four additional symptoms (change in appetite and/or weight; insomnia or hypersomnia; psychomotor retardation or agitation; feelings of worthlessness or excessive guilt; decreased concentration; fatigue or loss of energy; and recurrent thoughts of death or suicide). These symptoms must be present most of the day and nearly every day for at least two weeks and must represent a worsening relative to the individual's pre-episode state. They must also be associated with clinically significant distress or impairment in social or occupational functioning. Finally, the symptoms cannot be better accounted for by substance use or another medical condition (American Psychiatric Association, 2013). PND is distinct from what is commonly referred to as the 'baby blues', a transient period of low mood and tearfulness occurring in the days following birth, a common and expected phenomenon experienced by approximately 70% of postpartum women (Marcus & Heringhausen, 2009).

There is considerable debate in the literature on the parameters of the perinatal period and, by extension, the definition of PND (Batt et al., 2020). Technically in the DSM-5, depressive episodes that onset after 4-weeks following birth are classified as a depressive disorder without the perinatal specifier. In practice, however, many clinicians and researchers employ a more inclusive definition that spans pregnancy through one-year postpartum, as this aligns with the established risk period and facilitates more extensive depression screening and treatment (Dagher et al., 2021; Lewis Johnson et al., 2020; Ministry of Health, 2012b).

3.1 Assessment of Perinatal Depression

Diagnosis of PND requires comprehensive clinical assessment. However, there are several screening tools that help to identify people exhibiting clinically significant symptomology. Seven depression screening instruments have been validated for the assessment of PND and approved for use by the American College of Obstetrics and Gynaecologists (ACOG): the Edinburgh Postnatal Depression Scale (EPDS), Postpartum Depression Screening Scale, Patient Health Questionnaire

(PHQ-9), Beck Depression Inventory II (BDI-II), Centre for Epidemiologic Studies Depression Scale (CES-D), and the Zung Self-Rating Depression Scale (ACOG, 2018; Dagher et al., 2021). Of these measures, the EPDS is most frequently used in clinical and research contexts due to its brevity (10 items, completion time < 5 min), and its exclusion of somatic symptoms commonly experienced in the perinatal period (Dagher et al., 2021).

3.2 Prevalence of Perinatal Depression

PND is common; a systematic review of longitudinal studies of maternal mental health in NZ and Australia found that between 10% and 20% of women reported experiencing moderate to severe depressive symptomology for at least a few months in the year following birth, and that rates had remained relatively stable over the 25 years prior to the study's publication (Schmied et al., 2013). Almost 12% of pregnant women in the GUiNZ study scored 13 or higher on the EPDS, indicating they likely met diagnostic criteria (Waldie et al., 2015). The study showed rates were higher among women of non-European ethnicities, particularly among Pacific, Asian, and "Other" (including Middle Eastern, Latin American, and African) ethnic groups. Additionally, prior work within *Moe Kura* has shown that Māori women are at higher risk of experiencing clinically significant levels of PND symptoms [22.4%, (95% CI 18.4%-26.5%)] compared to non-Māori women [15.3% (95% CI 12.7% - 17.9%)] (Signal et al., 2017).

These rates are higher, on average, than seen elsewhere. Woody et al. (2017) conducted a systematic review of 101 studies to provide pooled prevalence estimates for high and low/middle income countries, adjusted for a selection of variables identified through a meta-regression model. The authors estimated that overall, the global pooled prevalence of PND at the time of the study was 11.9% (95% CI 11.4%-12.5%), with higher rates among low/middle income countries [13.1% (95% CI 12.2%-14.1%)] compared to high income countries [11.4% (95% CI 10.8%-12.1%)]. All regions of the world (as grouped by the World Bank) were represented in the review. However, Woody et al. (2017) note that availability of prevalence data from low-income countries

was poor, with a large predominance of studies from high income counties, particularly Western Europe. This suggests the true global prevalence may have been higher.

Many methodological factors impact prevalence estimates, including measurement timeframes. In their systematic review, Schmied et al. (2013) found that women's mood appeared to be better in the first year after birth, when compared to during pregnancy and five years later. This echoes findings from previous work within *Moe Kura*, that for both Māori and non-Māori women, depressive symptoms were significantly better at 12 weeks postpartum than during pregnancy or at 3-years post-birth (Ladyman et al., 2021). The relative improvement of PND symptomology in the postpartum period might reflect greater awareness of and support for women experiencing postnatal compared to prenatal depression, and wider availability of services (e.g., via Lead Maternity Carers and public health programmes such as Whānau Awhina Plunket).

Rates of depression, including PND, increased during the COVID-19 pandemic and appear to remain elevated. The WHO reported the global pooled prevalence of depression and anxiety increased by 25% in the first year of the COVID-19 pandemic, with women more severely affected than men (WHO, 2022). Caffieri et al. (2024) conducted an umbrella review of 25 systematic reviews (198 primary studies) and 12 meta-analyses (129 primary studies), with data included from 5 continents and 45 countries. They estimated that the global prevalence of antenatal and postnatal depression during the pandemic was 29% and 26%, respectively (Caffieri et al., 2024). There is no evidence yet to suggest prevalence levels have returned to pre-pandemic levels (Terry & Hudson, 2024).

3.3 Aetiology of Perinatal Depression

Like other depressive disorders, PND arises from an interaction of biological factors (e.g., hormonal, genetic, neurological) and psychosocial factors (e.g., stressors, adverse life experiences, low social support) (Batt et al., 2020). Much of the aetiology of PND is shared with depressive

disorders outside the perinatal period, though there are several unique factors that map to the specific changes and challenges associated with pregnancy, birth, and the transition to parenthood (Batt et al., 2020). It is important to understand common and unique aetiological factors to fully comprehend the implications of PND for maternal and child wellbeing.

Genetic Factors

Research suggests PND and MDD have similar genetic underpinnings; with polymorphisms of catechol-O-methyltransferase [COMT], serotonin transporter [5HTT], and monoamine oxidase (MAO) genes implicated in both disorders (Couto et al., 2015). It is possible that other gene(s) that differentiate PND from MDD exist, but none have yet been identified (Couto et al., 2015). Pointing to potential genetic differences, PND appears to have higher heritability than MDD (Viktorin et al., 2016).

Hormonal Factors

The pathogenesis of depression is associated with hypothalamic-pituitary-adrenal (HPA) axis dysregulation, which is seen in both PND and MDD (Glynn et al., 2013; Magiakou et al., 1996; Maguire, 2019). Hormonal factors unique to PND include those that are specific to pregnancy, birth, and postpartum. However, despite the clear temporal relationships between changes in reproductive hormones and onset of the PND, studies do not find consistent associations between PND and perinatal hormone levels, rates of postnatal hormone withdrawal, or larger hormonal fluctuations (Payne & Maguire, 2019). For example, levels of oestrogen – a reproductive hormone with antidepressant effects – rise to over 1000 times above baseline in lead up to birth before dropping precipitously after delivery. Findings are similarly mixed on whether higher progesterone levels are associated with increased or decreased risk for PND (Payne & Maguire, 2019).

These inconsistencies may reflect the heterogeneity of study populations and methodologies, as well as the complex neuroendocrine mechanisms at play. Emerging research points to the role of allopregnanolone, the neuroactive metabolite of progesterone, and its action on $GABA_A$ receptors. As GABA is the brain's primary inhibitory neurotransmitter, enhanced activity at $GABA_A$ receptors signalled by allopregnanolone can produce anxiolytic and antidepressant effects. Growing evidence indicates changes in allopregnanolone levels and GABA signalling across the perinatal period are relevant to PND development. Thorough reviews of these and other mechanisms are provided by Payne and Maguire (2019) and Licheri et al. (2015).

Underscoring the unique role of reproductive hormones in PND, studies show PND is more commonly experienced by women who are prone to depressive symptomology during other times of significant reproductive hormonal fluctuation (e.g., during the premenstrual phase, while taking hormone-based contraceptives), and women with a history of PND are more likely to develop MDD during menopause (Batt et al., 2020). An umbrella review of systematic reviews and meta-analyses reported premenstrual syndrome was the factor most reliably associated with PND (Gastaldon et al., 2022).

Neurological Factors

Functional magnetic resonance imaging (fMRI) studies indicate similar neurological processes at play in PND and MDD. Both are associated with decreased activation in reward-related brain regions (e.g., ventral striatum) in response to positive cues (Batt et al., 2020). Symptoms of PND are associated with reduced reward-related striatal activity, both during pregnancy (Mulligan et al., 2019), and postpartum (Moses-Kolko et al., 2011). Laurent and Ablow (2012) found that mothers experiencing PND produced hypoactive neural responses to emotional stimuli related to their own infant (e.g., their infant's cry). The authors posited that hypoactivity in striatal and thalamic networks may contribute to difficulties for mothers experiencing PND to feel a sense of reward from approaching their distressed infants, impacting their motivation to do so (Laurent &

Ablow, 2012). They also suggest that the observed differences in reward-related brain regions might contribute to difficulties organising a response repertoire during infant interactions (Laurent & Ablow, 2012).

Psychosocial Factors

PND and depressive disorders outside the perinatal period share many common psychosocial risk factors, including chronic life stress, socioeconomic deprivation, and adverse childhood experiences such as abuse or neglect (Guintivano et al., 2018; Hammen et al., 2009; Heim & Binder, 2012; Yim et al., 2015). Indeed, a personal history of another depressive disorder is often cited as one of the strongest predictors of PND (Schmied et al., 2013; Yang et al., 2022). However, a meta-analysis by Stevens et al. (2019) shows the range of reported rates of PND among women with a history of MDD varies widely across studies (1%-75%), with the mean risk of depression recurrence at 8%; perhaps lower than might be expected given the stable aetiological factors common to MDD and PND discussed above. Rates of recurrence were significantly lower among women who continued antidepressant treatment throughout pregnancy (Stevens et al., 2019).

Social support is a well-established protective factor against depression generally, and low social support is consistently and strongly associated with depressive symptoms (Batt et al., 2020). This may be especially true for PND, where social support can attenuate the harmful effects of unique perinatal stressors, such as pregnancy, birth, and childcare (Sufredini et al., 2022). Partner support and relationship satisfaction appear to be particularly relevant to PND (Biaggi et al., 2016; Henshaw et al., 2023; Lancaster et al., 2010). Other psychosocial risk factors for PND highlighted in systematic reviews include current domestic violence, and unplanned or unwanted pregnancy (Biaggi et al., 2016; Gastaldon et al., 2022; Ladyman et al., 2021; Lancaster et al., 2010).

3.4 Consequences of Perinatal Depression

Globally, depressive disorders have remained among the top three causes of non-fatal health loss for more than a quarter century (GBD & Injury Incidence Prevalence Collaborators, 2018). It is well established that PND is associated with short- and long-term negative outcomes for maternal and child health and well-being (Dunkel Schetter & Tanner, 2012; Korhonen et al., 2012; Ladyman et al., 2021; Leigh & Milgrom, 2008). Most severely for women, PND can result in suicide. Suicide is the leading cause of maternal death in NZ, and our rate of maternal suicide is seven times the rate in the United Kingdom (Perinatal Maternal Mortality Review Committee, 2018).

Perinatal Depression and General Child Development

In addition to the suffering and debilitation experienced by mothers, PND is a known risk factor for child developmental, cognitive, and socio-emotional difficulties that can persist into adolescence and adulthood at magnitudes of clinical and public health significance (Betts et al., 2014; Korhonen et al., 2012; Leigh & Milgrom, 2008; O'Donnell et al., 2014). Even high subclinical levels of depressive symptomology have been shown to have significant impact on child health outcomes, which is important given a substantially greater proportion of the population experience high subclinical PND than clinical PND (an estimated 29.3% versus 9.5%, respectively; Meaney, 2018). In a systematic review of studies that analysed maternal depressive symptoms as continuous variables, a range of depression severity was shown to impact child development (Meaney, 2018).

Much of the association between maternal prenatal mood and child outcomes is likely due to associated factors. Regularly attending antenatal care appointments can be more difficult for a woman experiencing depression (Field, 2011), and depression is associated with higher rates of alcohol use during pregnancy (Chapman et al., 2024). Genetic predisposition to mental distress, including PND, can be inherited (Couto et al., 2015; Viktorin et al., 2016), and women experiencing prenatal depression are more likely to experience postnatal depression, which can affect key

developmental determinants such as parent-infant interactions, attachment, and later parenting (Heron et al., 2004). Some studies suggest the quality of mother-infant attachment moderates some of the effects of prenatal depression (Bergman et al., 2010). Still, there is some evidence to suggest exposure to depression during pregnancy can directly cause changes in foetal development that contribute to adverse health outcomes. Glover et al. (2018) reviewed several large-scale community studies and found the association between antenatal mood and child outcomes remained, even after controlling for many key covariates. Burgeoning evidence from studies using neurocognitive assessment and more direct measures of brain functioning, such as electroencephalogram, event-related potential, and functional magnetic resonance imaging, indicates that antenatal exposure to depression is associated with alterations to several aspects of brain function in offspring (Van den Bergh et al., 2020).

The foetal programming hypothesis can be used to explain the cause and consequences of these alternations. According to this model, prenatal exposure to environmental factors, including depression – a form of stress – can influence "programming" of the foetus' health and development, with long-lasting or permanent effects (Barker, 1998; Davis et al., 2011; Galbally et al., 2018; Jagtap et al., 2023; O'Connor et al., 2014). Precisely how this occurs is not well established, though several biological mechanisms of effect are currently under investigation. A leading hypothesis implicates the changes in maternal HPA axis functioning that occurs with depression. These changes are thought to increase foetal exposure to glucocorticoids, such as cortisol, which may cause corresponding changes to foetal HPA axis functioning (Lewis et al., 2015). Other hypotheses involve epigenetic modifications, inflammatory processes, and alterations to foetal microbiome and placental functioning (Glover et al., 2018; Jagtap et al., 2023; Lewis et al., 2015). This field of research is relatively nascent and extremely complex; it is important not to overstate or oversimplify the apparent risk to offspring conferred by prenatal depression. Many children exposed to depression in utero appear wholly unaffected (Glover et al.,

2018), and yet there is accumulating evidence that, on balance, is highly suggestive of an association between prenatal depression and child outcomes.

3.5 Prenatal Depression and Sleep in Early Childhood

Sleep is one key developmental domain that appears to be implicated in the purported relationships between PND and child development, though it has received relatively little attention to date. Some studies have explored PND and infant sleep, and a smaller number have considered the impact of PND on sleep at later stages of child development.

Prenatal Depression and Infant Sleep

In one study, 32 infants were categorised as 'high risk' on the basis that their mothers were diagnosed with MDD during or prior to pregnancy. Their sleep was compared to that of demographically matched 'low risk' infants born to mothers with no history of MDD (total n = 64; Bat-Pitault et al., 2017). Sleep architecture was measured with polysomnography in the first week (usually the second day) following birth, and when the infants were 6 months of age. As newborns, the 'high risk' group exhibited proportionately more NREM sleep, fewer arousals, and more awake time than the 'low-risk' group. More between-group differences were evident at 6 months; the 'high-risk' group showed proportionately less REM sleep, fewer arousals, lower sleep efficiency, lower sleep duration, and increased time awake. Different trajectories in sleep development were also seen. Whereas the sleep efficiency of the 'low-risk' group remained stable across the first 6 months of life (60.7% ± 9.9% to 67.4% ± 13.9%), sleep efficiency in the 'high risk' group reduced (56.5% ± 10.8% to 40.3% ± 24.6%), reflecting poor sleep consolidation. Similarly, while 24-hour sleep duration reduced for both groups across the first 6 months, the reduction was significantly greater in the 'high-risk' group (newborn 671.5 ± 155.5 min to 6 months 406.2 ± 244.2 min), compared to the 'low-risk' group (newborn 699.5 ± 129.9 to 6 months 644.4 ± 143.7 min). These differences in sleep development were statistically significant (p values < .001). The findings of

Bat-Pitault et al. (2017) were broadly consistent with earlier work by Armitage et al. (2009) using actigraphy to measure infant sleep at two and 24 weeks of age. Here, mothers were assessed for depression in the third trimester of pregnancy. Infants were considered 'high-risk' if their mothers had historic or current MDD according to the Structured Clinical Interviews for DSM-IV (SCID) or scored 10 or greater on the EPDS at enrolment (n = 11). Five of these infants had mothers who were experiencing an MDD episode at enrolment, the remaining six had mothers with a history of MDD or an EPDS score greater than 10. These infants were compared to demographically matched 'low-risk' infants whose mothers had no personal or family history of MDD (n = 7). They found that while the groups did not differ at either time point in 24-hour sleep duration, they showed differences in the distribution of their sleep. Nighttime sleep differed markedly between the groups. At both time points, the 'high-risk' group of infants had 97 minutes' shorter nocturnal sleep duration. They woke more often at Week 2 (4.0 vs 1.9 nocturnal awakenings), and although both groups showed improved sleep consolidation over time, the 'high-risk' group continued to exhibit more night waking at Week 24 (2.3 vs 1.3 nocturnal awakenings). Nighttime sleep efficiency, an additional index of nocturnal awakenings, was significantly lower in the 'high-risk' group at both time points. The 'high-risk' infants also took longer to get to sleep at nighttime, with more than one hour difference in sleep onset latency at both time points. Daytime sleep between the two groups of infants did not differ in total sleep time (TST), however the 'high-risk' group exhibited more fragmented day sleep, with significantly more daytime sleep episodes of shorter duration. All Cohen's d effect sizes were large, ranging from 1.2 to 3.5, suggesting practically meaningful between group differences.

Studies using objective measures like polysomnography and actigraphy offer valuable insights into the relationship between maternal depression and infant sleep. However, these studies are usually limited by their small samples. Parent-report measures of child sleep can facilitate large-scale investigations that complement the smaller-scale, more clinically objective data. Dias and Figueiredo (2021) looked at the longitudinal impact of PND on infant sleep at 2 weeks, 3 months,

and 6 months of age (n = 312 mother-infant dyads). They found that higher scores on the EPDS during pregnancy predicted higher total scores on the Child Sleep Health Questionnaire Infant Version (CSHQ-I) at 3 and 6 months, indicating more sleep problems (r values = 0.217 and 0.194 respectively, p values < .01). These unidirectional relationships were driven by the subscales Unsettled Sleep (i.e., infant anxiety related to sleep and sleep disordered breathing and parasomnias) and Daytime Sleepiness (i.e., daytime consequences of sleep problems). There were no significant relationships with the remaining subscales; Positive Sleep Habits (i.e., infant bedtime and morning routines) and Bedtime Sleep Problems (i.e., infant resistance to go to bed and frequent night awakenings). Morales-Munoz et al. (2018) looked at multiple prenatal risk factors, including CEDS-measured depression, on infant sleep outcomes at 3 months. Like Dias and Figueiredo (2021), they found antenatal depression predicted infant sleep outcomes, but the specific outcomes implicated were different. Prenatal depression was associated with longer sleep onset latency and irregular sleep routines, but not with sleep duration, circadian rhythm development, self-soothing behaviour, night-waking, or bedsharing.

Prenatal Depression and Preschooler Sleep

Across early childhood, sleep undergoes rapid development. As discussed throughout Chapter 2, sleep/wake patterns change markedly in this period, and exhibit great variability (Borbély et al., 2016). A small number of studies have looked at the relationship between maternal prenatal depressive symptoms and sleep in preschoolers, including two prospective cohort studies (O'Connor et al., 2007; Toffol et al., 2019). Toffol et al. (2019) found children of women with clinically significant depression symptomology during pregnancy had shorter nocturnal sleep duration, longer sleep onset latency and higher odds of more frequent night waking, and higher odds of having a sleep disorder at age 3.5 years, compared to children of women with low symptomology during pregnancy. The study controlled for several obstetric and psychosocial covariates, and concurrent maternal depression at 3.5 years, but not for depressive symptoms during the postnatal period. O'Connor et al. (2007) looked at the impact of maternal prenatal

anxiety and depression on child sleep at 18 months (*n* = 7,458) and 30 months (*n* = 6,829) after controlling for several obstetric and psychosocial covariates, as well as prenatal, postnatal and concurrent depression. Here, total 'sleep problems' but not total sleep duration nor night awakenings was associated with maternal mental distress during pregnancy. Together, these studies suggest an imprecise but significant effect of antenatal depression symptoms on the emergence of sleep problems and provide tentative support for the foetal programming hypothesis.

3.6 Research Gaps and Inconsistencies

Not all studies find support for the purported maternal depression – child sleep relationships. For example, a study by Galbally et al. (2018) found neither prenatal depression, nor prenatal antidepressant use predicted infant sleep outcomes on the Brief Infant Sleep Questionnaire (BISQ) (Sadeh, 2004) at 6- or 12 months. Similarly, Tikotzky et al. (2021) explored the longitudinal links between perinatal distress (i.e., symptoms of depression, anxiety, and parenting stress) on infant sleep using both actigraphy and parent report via the BISQ. Infant sleep was measured at 3-, 12-, and 18 months (*n* = 150). While the researchers found a statistically significant correlation between depression/anxiety symptoms in the third trimester of pregnancy and subsequent parent-perceived sleep problems, the relationship was weak (*r* values < .2) and was not reflected in actigraphy or quantifiable questionnaire data (e.g., mother's reports of sleep duration and number of night-wakings). These findings raise questions as to whether the purported relationship might be an artefact of shared method variance, as mothers self-reported both their own symptoms and their infant's sleep.

The idea that depression can colour a mother's experience of her infant's sleep is supported by several studies focused on the impact of postnatal depression (Goldberg et al., 2013). Depression-related insomnia could render mothers more sensitive to their infants' nocturnal stirrings, and cognitive biases characteristic of depression could cause 'normal' sleep characteristics to be

perceived as problematic. The weak relationships and null findings published by Tikotzky et al. (2021) make an important contribution to the literature. The study raises important issues and highlights the need to control for postnatal depression when investigating the impact of prenatal depression on child outcomes. However, the study is not without limitations. At pregnancy only 4% of mothers (*n* = 9 of the initial 225) scored ≥ 13 on the EPDS, the clinical cut-off for depression. Just an additional 8% (*n* = 18) scored within the "minor depression" range of 10-12. The numbers of women with depression reduced further over the course of the study. On the EPDS at 18 months postpartum, just 2% of mothers scored ≥ 13 (*n* = 3 of remaining 150), and 3% (*n* = 5) scored 10-12. It seems likely that the levels of depression in this study were insufficient to detect an effect. Another important and related limitation was the study's homogenous sample. All participants were Israeli Jews of two-parent families expecting their first child, and most were of middle-high SEP.

Lack of ethnic and socio-economic diversity within samples is a significant limitation common to many studies in this field. While many studies fail to report ethnicity and SEP at all, it is apparent that Indigenous populations and groups with high socio-economic deprivation are particularly poorly represented. This limits the generalisability of study findings and severely compromises their ability to inform appropriate prevention and intervention programmes (Routen et al., 2022). As outlined in Chapter 1, under-representation of Māori in NZ research contributes to health inequities that violate te Tiriti o Waitangi/the Treaty of Waitangi. Sampling predominantly from groups with more privilege can also hamper a study's statistical power with constructs such as depression, because privilege itself is a powerful protective factor; socioeconomic disadvantage and racial discrimination are consistently associated with poorer general and sleep health outcomes in children and adults (Adler & Newman, 2002; Paine et al., 2019; Paine et al., 2016; Talamaivao et al., 2020).

In summary, sleep health in early childhood is the product of a complex interplay between numerous biopsychosocial factors, including PND. In NZ, ethnic inequities in sleep health that

disadvantage Māori are evident from preschool through adulthood, but it is not yet known if they are present in infancy. The socio-ecological factors associated with infant sleep are also not yet understood, nor the characteristics of mother-perceived infant sleep problems in the NZ context. Sleep may be one pathway by which PND confers risk for poor child health outcomes, but more research is needed. Accordingly, the aims of this thesis are to 1) characterise and compare the sleep of 12-week-old infants of Māori and non-Māori NZ women; 2) identify socio-ecological factors associated with infant sleep characteristics; 3) determine features of infant sleep that contribute to a mother-perceived infant sleep problem; 4) report sleep characteristics during infancy and early childhood of children born to mothers with and without clinically significant depressive symptomology; and 5) explore maternal perinatal depressive symptomology as a predictor of sleep patterns and problems during infancy and early childhood, controlling for maternal depressive symptoms at subsequent time points.

CHAPTER 4 METHODOLOGY

4.1 Overview

The studies presented in this thesis are based on secondary analysis of data from the *Moe Kura* project. This chapter provides more detailed descriptions of the methods used in the studies than afforded by the constraints of journal manuscripts. It explains the philosophical underpinnings and evolution of *Moe Kura* and situates the current research within the broader project. This chapter also provides more detail on methodological approaches and measures used in the current studies.

4.2 Philosophical Underpinnings of *Moe Kura*

It is important to thoroughly outlay the philosophical underpinnings of the broader *Moe Kura* study before detailing the specific methods of this thesis. As noted in Chapter 1, *Moe Kura* is informed by Kaupapa Māori epidemiological research methodologies. These methodologies constitute a tool with which Māori can exercise their essential right to monitor and evaluate Crown action and inaction, and to identify breaches of the Treaty and UNDRIP, indicated by disparities in health outcomes between Māori and non-Māori (HCSQ, 2019; Paine & Gander, 2013; Reid & Robson, 2007; United Nations, 2007).

As explained in Paine et al. (2020), "Kaupapa Māori epidemiology is not simply a "Māori way" of analysing, describing and explaining patterns and drivers of health or an "equity-lens" though which data can be filtered" (p. 193). Rather, it is a theoretically driven approach to quantitative health research that "speaks back to colonial interpretations of Māori health inequities as natural or due to innate problems with Māori communities or culture and argues for the right to use data and statistics to shift the gaze toward the organisation of society, and the role of the health system, including health policy, in creating and sustaining health inequities" (p. 193).

Three key Kaupapa Māori epidemiological research principles underpin *Moe Kura*:

1) **Equal explanatory and analytical power for Māori and non-Māori.** The principle of Mana Whakamārama, or equal explanatory power, aims to address problems caused by "representative" sampling methods that inevitably produce evidence that favours numerically dominant groups (Simmonds et al., 2008). In the NZ context, this causes the unique experiences and needs of Māori to be subsumed within those of the total population (Paine et al., 2020). Representative sampling prevents proper examination of inequities and therefore precludes the development of meaningful interventions for those in need. To address this, Māori representation in health research must be increased so that studies have sufficient statistical power to conduct analyses for Māori that are as robust as those for non-Māori, thereby enabling prevalence estimates for Māori and non-Māori populations, as well as between-group comparisons (Paine et al., 2020). This approach, which intentionally increases Māori representation in health research, has been criticised as "over-sampling". While the approach necessarily produces datasets where Māori are "over-represented" relative to the national population, the benefits of this approach in terms of its potential to produce results that help uphold the rights of Māori under the Treaty and UNDRIP, far outweigh any cost of not adhering to traditional, Western epidemiological methodologies. The principle of equal explanatory power informed all stages of *Moe Kura*, including the sampling approach, participant recruitment and retention strategies, and the development of analyses. All analyses support structural- rather than individual-level exploration of sleep health inequities and their determinants.

2) **Māori participation and control at all levels and stages of the research, including with a Māori co-Principal Investigator.** This principle extends from the former in that while statistical power is necessary for 'equal explanatory and analytical power', it is not sufficient. Well-powered statistics can show differences in health status, but they are of limited use without informed interpretation to highlight causes and propose appropriate

solutions (Paine et al., 2020). It is important that Māori health data is interpreted carefully, in the context of historical and contemporary realities, and under Māori leadership. Dr. Sarah-Jane Paine is the kaitiaki (guardian) of Māori participants and their data for all *Moe Kura* research and is a supervisor of this thesis.

3) **Appropriate collection of ethnicity data to identify and monitor health disparities, and rejection of deficit-framed interpretations of the data.** Extending from principles one and two, and reflecting rights of Māori to monitor Crown (in)action, this principle aims to go beyond appropriate comparisons to identify *where* inequities exist, to *why* they exist, including the roles of systemic racism, power, and privilege. As explained in Paine et al. (2020), a rejection of deficit-framed interpretations does not mean strict adherence to resilience-based frameworks for analyses, as by definition, these frameworks "are concerned with identifying the factors and behaviours that enable individuals and communities to survive in the face of ongoing coloniality and structural violence… buying into the colonial binary of "good" and "bad" Māori and invisibilizing the way in which interlocking systems of oppression operate to structure the lives of Indigenous People over generations" (p.199). Instead, as Smith and Smith (2019) assert, "it is important to have a nuanced, theorized, and accurate understanding of what has gone wrong in order to develop more effective transforming responses" (p.4). In line with this principle, this thesis aims to propose explanations for any observed inequities that are grounded in theory and evidence and focused on advancing Māori well-being.

4.3 The Evolution of *Moe Kura*

Between 2009 and 2010, pregnant women (423 Māori and 763 non-Māori) across NZ were enrolled in a study of sleep and perinatal health, then titled *'E Moe, Māmā: Maternal Sleep and Health in Aotearoa/New Zealand'* (*E Moe, Māmā*). *E Moe, Māmā* is a Te Reo Māori name that translates to "sleep mother, go to sleep mother". Participants responded to a comprehensive

questionnaire at approximately 35-37 weeks gestation (T2) that asked retrospectively about their pre-pregnancy mental health and sleep health (T1), and their current sleep, physical, and mental health. A brief phone interview assessing maternal sleep and mental health was conducted at approximately 6 weeks postpartum (T3), and a comprehensive questionnaire on maternal sleep, physical, and mental health, and infant health and sleep was completed at approximately 12 weeks postpartum (T4). Between 2012 and 2015, a second phase of the study was conducted in which mother-child dyads who had participated in *E Moe, Māmā* were invited to complete follow-up questionnaires when the *E Moe, Māmā* child was three years of age (T5). The follow up questionnaires at T5 continued to explore maternal sleep and physical and mental health, with many of the same measures used at T2 and T4, and T5 included an additional questionnaire titled *Child Sleep and Health*. In 2013, the study was renamed *Moe Kura: Mother and Child, Sleep and Wellbeing in Aotearoa/New Zealand (Moe Kura)*, to reflect the study's expanded focus to the role of sleep health in whānau (family) well-being. This name was gifted to the study by the late Dr Te Huirangi Waikerepuru (Taranaki, Ngāpuhi), he explained "*Moe Kura is based in the concept of te au Moe Kura i te ao mārama: the peaceful treasured sleep as of the child into the world of ancient wisdom, wonderment and light*". The research in this thesis uses data collected during pregnancy (T2), at 12 weeks postpartum (T4), and three years post birth (T5).

4.4 Ethical approval

Ethical approval for *E Moe, Māmā* was granted by the NZ Central Health and Disability Committee (HDEC) in October 2009 (CEN/09/09/070). Ethical approval for *Moe Kura* was granted as an emendation in November 2012 (CEN/09/09/070/AM02). The research in this thesis is within the scope of these approvals and was noted in the 2020 annual report to HDEC.

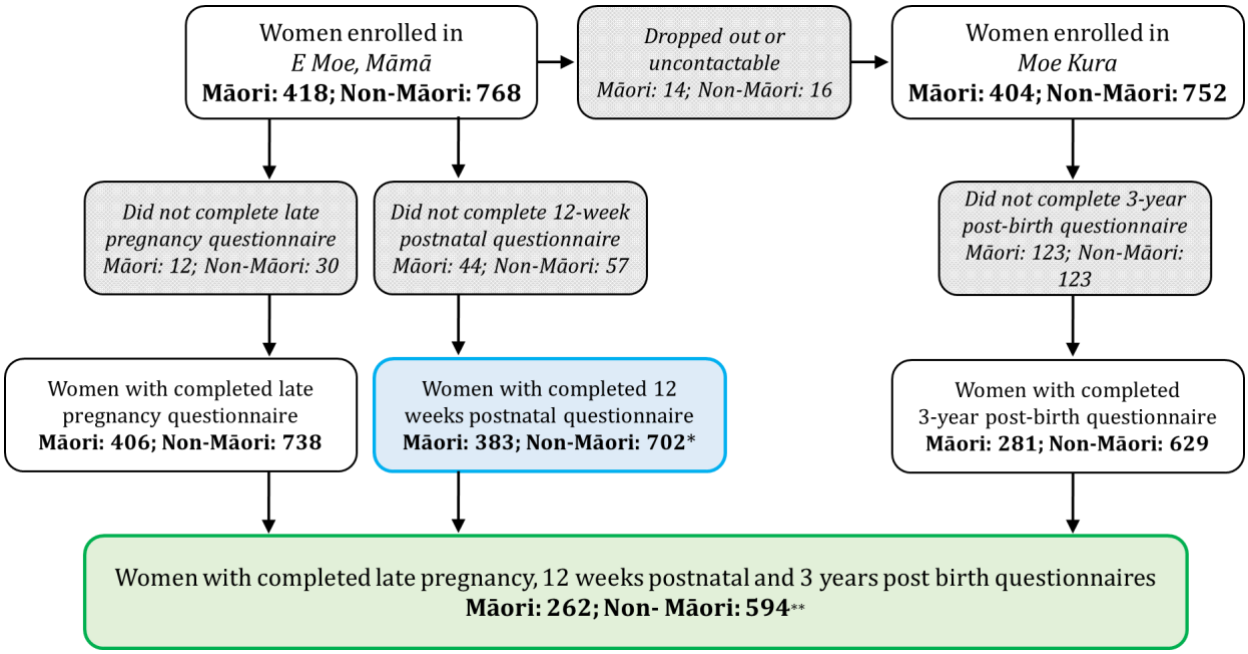
4.5 Recruitment

Recruitment for *E Moe, Māmā* began in the Lower North Island of NZ before expanding nationwide to increase Māori representation, with the goal of equal analytical and explanatory power for Māori and non-Māori (Paine & Gander, 2013). To this aim, recruitment of Māori participants also continued for a longer period than non-Māori. Recruitment was conducted via convenience sampling from October 2009 through September 2011.

4.6 Inclusion criteria

Minimal inclusion and exclusion criteria were used in order to obtain the most representative sample of self-selected, community-based women. Women needed to be aged 16 years or older, be able to respond to questionnaires in English, and have a singleton pregnancy. Mother-child dyads from *E Moe, Māmā* were invited to participate in *Moe Kura*, there was no additional recruitment. Figure 4.1 presents a flow diagram of study participants, including the merging of studies. It also highlights the data subsets used in Study 1 (blue) and Study 2 (green) of this thesis.

Figure 4.1: *Flow diagram of E Moe, Māmā and Moe Kura participants*



Note: Adapted with permission from Ladyman (2019), personal communication, 30 Oct 2024. Study 1 sample indicated in blue; Study 2 sample indicated in green. *Ethnicity as measured at 12 weeks post-partum, consistent with Study 1 methodology; **Ethnicity as measured at pregnancy, consistent with Study 2 methodology.

4.7 Questionnaires

Pregnancy questionnaire (T2 & T1)

The 58-item, 12-page questionnaire titled *Sleep and Health during Pregnancy* was developed in 2009 (Appendix 1). Participants were asked to complete the questionnaire between 35-37 weeks gestation. The questionnaire included items on demographics, sleep and mental health in pregnancy, general health, obstetric history, and life stress (T2), as well as some retrospective questions on sleep and mental health prior to pregnancy (T1). The demographic information collected included maternal age, gestation, ethnicity, SEP, employment status, sources of support, and relationship satisfaction.

Postnatal questionnaire (T4)

Participants were asked to complete a second, 91-item, 27-page questionnaire titled *Postnatal Sleep and Health* when their infant was 11-13 weeks old (Appendix 2). Items on maternal demographics, sleep, mental health, and general health were repeated and new items pertaining to birth and the infant were incorporated. Items pertaining to the infant included age, health, feeding, sleep locations during the day and at night, sleep patterns, and whether the infant's sleep was considered a problem.

Three-years post birth questionnaire (T5)

At this data collection point, the study's name changed to *Moe Kura*. Data collection commenced on 21 December 2012 and was completed on 30 April 2015. Participants from *E Moe, Māmā* were contacted no earlier than five weeks prior to their child's third birthday. Here, a two-part questionnaire was included; a 90-item, 26-page section titled *Your Sleep and Health* (Appendix 3) and a 67-item, 19-page section titled *Your Child's Sleep and Health at 3 Years* (Appendix 4). Again, the questionnaire captured maternal demographics, sleep, general health, and mental health information. The child section included items pertaining to demographics (including child sex, first captured here), general health, and child sleep - including sleep patterns, behaviours, and perceived problems.

4.8 Measures

Demographic Measures

Maternal and child ethnicity was identified by mothers with census item "Which ethnic group do you [does your child] belong to? Mark the space or spaces that apply to you [your child]". Consistent with Stats NZ (2019a), participants were categorised as Māori if they marked 'Māori' alone or with (an)other ethnic group(s), all others were categorized as non-Māori.

Maternal and child age was calculated by subtracting the respective dates of birth from the questionnaire's completion dates.

Gestational weeks was calculated by subtracting the questionnaire's completion date from the mother's self-reported due date.

Socioeconomic position (SEP) was defined using the NZ Index of Deprivation (NZDep2006; Salmond et al., 2007). This is a widely used area-based measure of socioeconomic deprivation in NZ based on nine census variables to estimate the level of material deprivation, including: income via employment, income via means tested benefit, home ownership, support (single parent household), employment status, qualifications, living space (bedroom availability relative to household composition), communication (access to a telephone), and transport (access to a car). High deciles indicate greater deprivation.

Parity was assessed at T2 (pregnancy) by asking participants the total number of times they had given birth to an infant, alive or not, after 20 weeks' gestation. At T5 (3-years post birth) mothers were asked if they had had another baby (or babies) since the birth of their *E Moe, Māmā* child. Responses were dichotomised (nulliparous/multiparous at T2; caring for younger child(ren) at T5: no/yes).

Employment status was measured by asking participants whether they were currently employed for pay, profit, or income. Reponses options were No; Yes, one paid job; or Yes, more than one paid job. These were subsequently dichotomised to No/Yes.

Partner relationship satisfaction was measured with a 0-7 Likert scale item, "if you have a partner, how is your relationship with them at the moment?", where 0 represented "perfectly happy" and 7 represented "extremely unhappy". Participants had the option to select "not applicable". Consistent with prior work (Ladyman et al., 2021; Signal et al., 2017), a dichotomised

variable was created where < 3 indicated greater satisfaction and ≥3 indicated less satisfaction or not applicable.

Life stress was assessed using the 13-item Pregnancy Risk Monitoring System (PRAMS; Shulman et al., 2018) questionnaire at T2. Participants were asked whether, in the past 12 months, they had experienced the following: hospitalisation of a close family member; partner separation; moved to a new address; homelessness; partner lost job; participant lost job; argued with partner more than usual; pregnancy unwanted by partner; unable to pay bills; in a physical fight; partner or participant went to jail; close other with alcohol or other drug difficulties; death of a close other. High stress was defined as ≥2 stressors, in line with prior studies (Ladyman et al., 2021; Signal et al., 2017).

Depressive symptom measures

Depressive symptomology during the perinatal period (T2-T4) was assessed using the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holdenand, et al. (1987). The EPDS is considered an adequate and feasible screening tool for the assessment of PND in primary care (Gerbasi et al., 2020; Marquez & Miller, 2024; Rafferty et al., 2019). It is reliable and well-validated for use in predicting depression and assessing depressive symptomology, and is recommended by the American College of Obstetricians and Gynaecologists and the Royal Australian and NZ College of Obstetricians and Gynaecologists (ACOG, 2018; Marquez & Miller, 2024; Rafferty et al., 2019; Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2022). Importantly, the EPDS does not include somatic symptoms of depression, such as changes to appetite and sleep, which commonly occur in the perinatal period (ACOG, 2018). The measure is comprised of 10 items scored on a 4-point Likert-type scale. Possible scores range from 0-30, with higher scores indicating more distress. Scores of 13 or more are considered clinically significant (Cox, Holden, et al., 1987; National Institute for Health and Care Excellence (NICE), 2020).

The EPDS is not considered an appropriate measure of depression outside of the perinatal period. As such, depression symptomology at 3-years post-birth (T5) was measured with the Kessler 10 Item Scale (K-10; Andrews & Slade, 2001; Kessler et al., 2002). As with the EPDS, the K-10 is commonly used in research and clinical practice (Hoffman et al., 2022). The K-10 was initially developed for use in the annual U.S. National Health Survey (Andrews & Slade, 2001), and has been used in NZ national surveys since 2003/2004 (Browne et al., 2010). The K-10 can be used to assess past-month symptomology. Possible scores range from 0-40, with higher scores indicating more distress. Scores of 12 or more are considered clinically significant (Browne et al., 2010). As outlined in section 6.1.3, some analyses were reported using mothers' scores on the EPDS and K-10 (a continuous variable indicating the extent of depressive symptoms), whereas other analyses dichotomised mothers' scores into categories based whether clinically significant depression symptomology was present (≥ 13 EPDS, ≥ 12 K-10), or absent (scores < 13 EPDS, < 12 on K-10).

Infant sleep measures

Infant sleep location data at night and during the day were obtained from four multi-choice items taken from the Brief Infant Sleep Questionnaire (BISQ; Sadeh, 2004). Night sleep room and sleep surface variables were combined to provide a more detailed picture of infant sleep location and to facilitate comparisons to existing literature (Fu et al., 2008; Moon et al., 2022). Responses that indicated the infant slept on a separate surface (cot or bassinet) in the parent room were classified as *room-sharing*; responses that indicated the infant slept in the parent room and parent bed were classified as *bed-sharing*; responses that indicated the infant slept in their own room, in cot or bassinet were classified as *independent sleep*. The remaining categories were *sibling room in cot or bassinet*, and *other*. Due to more variability in daytime sleep location, these response options remained as listed in the questionnaire except for *Cot* and *Bassinet*, which were combined. When generating descriptive statistics, each sleep location was analysed separately and coded as 'yes' or 'no', as many respondents selected multiple options to these items. To account for sleep location in our multivariable models, all respondents who selected 'parent bed' in response to the

night sleep surface question were classified as bed-sharers and were compared to all others. *Night sleep location change* was assessed with the question(s) *In the last week did your baby start their night sleep in one location, and then move to another location during the night? If "Yes", on how many nights did they change their sleep location?*

Infant sleep continuity was assessed with the following variables: Night waking; *How many times does your baby usually wake up between 10pm and 6am (0/not at all, 1, 2, 3, 4 or more times)*, Night LSRSP; *What is the longest stretch of time that your baby is asleep during the night without waking up? (Less than 30 min, 30 min-1 hr, 1-2 hr, 2-3 hr, 3-4 hr, more than 4 hr)*, Day LSRSP; *What is the longest stretch of time that your baby is asleep during the day without waking up? (Less than 30 min, 30 mins-1 hr, 1-2 hr, 2-3 hr, 3-4 hr, more than 4 hr),* and 'Help to sleep'; *How often does your baby go off to sleep with help from others? (Never, Rarely, Often, Always).*

The variables **reasonable maternal sleep** and **opportunities for maternal daytime breaks** tapped into the impact of infant sleep on opportunities for adequate sleep and rest for the mothers themselves. These variables were assessed with the items *How often do your baby's sleep patterns allow you to get a reasonable, total amount of sleep in 24 hours?* and *How often do your baby's daytime sleep patterns allow you to have a break? (0/no days, 1, 2, 3, 4, 5, 6, 7/everyday)*, respectively. These levels were collapsed into *0/Never, 1-3 days, 4-6 days, 7/Always*.

Day-to-day change/Consistency in infant sleep patterns was assessed with the item *How much do your baby's sleep patterns change from day to day? (Always the same, change occasionally, change often, every day is different).*

Perceived infant sleep problem was assessed with an item from the original BISQ (Sadeh, 2004): *In general, do you consider your child's sleep a problem? (A very serious problem, a small problem, not a problem at all)*. This was dichotomized to create our ***perceived sleep problem*** variable; affirmative responses were coded as 'yes', the negative response was coded as 'no'.

Pre-schooler sleep measures

Child sleep at T5 was assessed using a subset of items from the Children's Sleep Habits Questionnaire (CSHQ). The CSHQ is a widely used parent-report questionnaire comprising 33 items scored on a 3-point Likert-type scale. It is designed to screen for childhood sleep problems (Owens et al., 2000). Originally designed for use with school-aged children, the CSHQ has been validated for use with toddlers and pre-schoolers (Goodlin-Jones et al., 2008). Questions from the CSHQ on the following three topics were used:

Sleep duration on weekdays and weekends were measured with two items from the CSHQ pertaining to usual sleep durations per 24 hours, including naps: "*What is your child's usual amount of sleep each* ***week*** *day/night, i.e., Sunday to Thursday night? (combining night time sleep and naps)".* This question was repeated for ***weekend*** sleep (i.e., Friday and Saturday). Consistent with NSF sleep duration guidelines (Hirshkowitz et al., 2015) and prior research (Muller et al., 2019c), *sleep duration* variables were categorised as short (< 10 hr)/ recommended (10-13 hr)/ long (> 13 hr).

Sleep timing was assessed with CSHQ questionnaire items pertaining to the child's usual bedtimes and sleep start times during the week (Sunday to Thursday) and on weekends (Friday and Saturday), and usual wake times during the week (Monday to Friday) and on weekends (Saturday and Sunday). *Midsleep difference* was calculated as the absolute difference, in hours, between weeknight and weekend midsleep times (i.e., the midpoint between a child's usual sleep start and wake times). Midsleep difference was dichotomised to produce a *social jetlag* (≥ 1hr vs. < 1hr) variable, consistent with Muller, Paine, et al. (2020).

Perceived pre-schooler sleep problem was assessed with a single item asking how much of a problem the respondent found their child's sleeping patterns or habits; "no problem, small problem, moderate problem, large problem". Responses were dichotomised to moderate/large vs. no/small problem.

Note that the infant and preschooler perceived sleep problem variables are dichotomised differently. The rationale for this relates to the different 'perceived problem' questionnaire items used at T4 and T5. As noted in section 4.10.3, the 12-week questionnaire used an item from the original BISQ – affirmative response options were "a very serious problem", "a small problem". A very small number of respondents endorsed the former, hence there was insufficient statistical power to look at 'very serious problems' alone. Additionally, in comparing the response distributions at 12 weeks and 3 years it appeared that that in the absence of other response options, the 12-week "small problem" variable is likely to have captured all perceived problems that fell short of 'very serious (incl. moderate, maybe even 'large' problems). Conversely, at 3 years, affirmative response options were "large problem", "moderate problem" and "small problem", which afforded clearer distinction. Dichotomising the variables in this way ensured mothers experiencing sleep problems at 12 weeks were not excluded on the basis that we could not accurately distinguish severity, while also ensuring "small" problems were not conflated with "moderate-severe" problems at 3 years, because these are considered qualitatively different.

4.9 General statistical methods

All analyses were conducted in IBM SPSS (version 28). Descriptive analyses were conducted using independent *t*-tests for continuous variables and chi-square tests for categorical variables. Multivariable and ordinal logistic models measured associations between different socio-ecological factors and infant sleep. Binary logistic models examined longitudinal associations between PND and infant and preschooler sleep, adjusting for key socio-demographic variables. Specific statistical analyses for the respective studies are detailed in chapters 5 and 6.

CHAPTER 5 CHARACTERIZING THE SLEEP LOCATION, PATTERNS, AND MATERNALLY PERCEIVED SLEEP PROBLEMS OF THE INFANTS OF MĀORI AND NON-MĀORI MOTHERS IN AOTEAROA NEW ZEALAND

This first study focuses on research gaps identified in Chapter 2. First, that ethnic inequities in sleep health that disadvantage Māori are evident from preschool through adulthood, but it is not known yet if they are present in infancy. Second, that more research into the socio-ecological factors associated with infant sleep and perceived sleep problems is needed, particularly with ethnically and socioeconomically diverse samples. This study aims to answer these important questions and in doing so, contribute to our understanding of paediatric sleep health and sleep health equity in NZ.

5.1 Study One

Carter, M. L., Paine, S.J, Sweeney, B. M., Taylor, J. E., & Signal, T. L. Characterizing the sleep location, patterns, and maternally perceived sleep problems of the infants of Māori and non-Māori mothers in Aotearoa New Zealand. *Sleep Health* (in press).

Abstract

Objectives: To investigate potential sleep inequities between the infants of Māori and non-Māori mothers in Aotearoa New Zealand, identify socio-ecological factors associated with infant sleep, and determine features of infant sleep that contribute to a mother-perceived infant sleep problem.

Design: Secondary analysis of longitudinal data from the *Moe Kura: Mother and Child, Sleep and Wellbeing in Aotearoa New Zealand* study when infants were approximately 12 weeks old.

Participants: 383 Māori and 702 non-Māori mother-infant dyads.

Methods: Chi-square and Independent T-tests measured bivariate associations between maternal ethnicity and infant sleep characteristics. Multivariable and ordinal logistic regression models assessed the relative impact of different socio-ecological factors on infant sleep outcome variables.

Results: Key developmental markers of infant sleep did not differ by maternal ethnicity. There were some ethnicity-based differences in sleep location. Maternal ethnicity, maternal age, parity, maternal depression, maternal relationship status, life stress, breastfeeding, work status, and bedsharing were related to different dimensions of infant sleep, and to maternal perceptions of a sleep problem.

Conclusion: Sleep at 12 weeks is highly variable between infants and is associated with numerous socio-ecological factors. Findings support a social determinants explanation for sleep health inequities seen later in childhood.

Keywords: ethnicity, socio-ecological factors, sleep health equity, infant sleep development, breastfeeding, maternal depression

Introduction

Sleep predicts child development in myriad ways, including physical, cognitive, and emotional development (El-Sheikh & Sadeh, 2015) and is recognized as essential to child health (Marsh et al., 2019). Additionally, both infant sleep and expectations around infant sleep impact maternal wellbeing (Barry, 2021a; Tikotzky et al., 2021). Despite awareness of the importance of sleep for child health and family harmony (Muller et al., 2019b), it is difficult to determine what is normative versus problematic sleep in young infants (e.g., ~12 weeks of age) because few studies have provided detailed descriptions of their sleep-wake characteristics.

In Aotearoa New Zealand (NZ), there are sleep health inequities between Māori, the Indigenous people of NZ, and non-Māori adults, and in children as young as 3-4 years (Paine & Muller, 2023).

Health inequities are unjust, modifiable disparities in health between socially or economically disadvantaged groups and their more advantaged counterparts (Braveman, 2014). Early inequities in sleep health are thought to contribute to long-term inequities in wellbeing (Billings et al., 2021; Muller, Paine, et al., 2022). The primary aim of this study was to explore whether sleep health inequities between the children of Māori and non-Māori mothers are present as early as 12 weeks of age, as this can further our understanding of when and why they develop.

The development of organized sleep-wake patterns occurs as a function of two interacting biopsychosocial processes: consolidation and self-regulation (Goodlin-Jones et al., 2001). Sleep consolidation describes the gradual development of a diurnal sleep pattern, with longer periods of sleep during the night, combined with longer periods of wakefulness during the day.(Goodlin-Jones et al., 2001) Sleep self-regulation refers to an infant's capacity to independently transition between wakefulness and sleep (Goodlin-Jones et al., 2001). Emergence of the circadian timing system at 8-12 weeks helps to initiate these processes (Jenni & Carskadon, 2009), facilitating changes to sleep-wake patterns that are especially rapid in the first year of life and which continue throughout childhood (Galland et al., 2012). Their maturation is marked by fewer signalled night wakings, less reliance on caregivers to initiate or resume sleep, and a greater longest self-regulated sleep period (LSRSP) – i.e., the longest period of "uninterrupted" sleep (as experienced by the caregiver) the infant obtains (Henderson et al., 2011).

Socio-ecological models of sleep health propose several nested layers of factors relevant to infant sleep development (Meltzer et al., 2021). At the most proximal, microsystem-level are factors intrinsic to the infant, such as age. The mesosystem includes parent-child interaction factors, including breastfeeding, bedsharing and family routines, which have bi-directional relationships with parent wellbeing such as mental health, life stress, and partner relationship satisfaction. More distally, SEP is associated with macrosystem factors including housing conditions. SEP has a strong association with health generally (R. Harris et al., 2006), and paediatric sleep health specifically (Paine & Muller, 2023). A further aim of this study was to identify socio-ecological

factors associated with infant sleep characteristics, with a focus on sleep location and markers of infant sleep development.

A final aim was to understand how infant sleep and socio-ecological factors relate to maternal perceptions of infant sleep problems. It is important to understand potential drivers of perceived problems, as they index one of the most common reasons for presentation to paediatric services and can be distressing for parents (D'Souza et al., 2023; Goodlin-Jones et al., 2001). Though consolidation and regulation are important processes, it is normal to see large between-child variability in the speed and linearity of these processes (Barry, 2021a; Galland et al., 2012). Historically, paediatric sleep research, at least in western psycho-medical contexts, has been predicated on "sooner the better" assumptions regarding sleep consolidation and regulation (Barry, 2021a; D'Souza & Cassels, 2023; Goodlin-Jones et al., 2001). Several studies have found night waking and shorter LSRSP commonly characterize parent-identified sleep problems (Henderson et al., 2013; Mindell et al., 2022; Sadeh et al., 2011). This contrasts with anthropologically informed perspectives that consider signalled night wakings throughout infancy to be functional, particularly for nutrition and attachment (Ball, 2013; Barry, 2021a; D'Souza & Cassels, 2023).

Irrespective of perspective, previous research indicates one third to one half of parents view their infant's sleep as problematic (Bayer et al., 2007; J. A. Mindell et al., 2017; Sadeh et al., 2011). This points to possible widespread distress given how central sleep is to family wellbeing (Muller et al., 2019b). Understanding how mother-identified sleep problems are characterized for 12-week-old infants may assist in ameliorating that distress, whether by identifying and addressing potential contributing contextual factors, targeting infant sleep behaviours, or helping parents to understand infant sleep, in order to modify expectations and perceptions.

In summary, we know infant sleep health is important and that sleep health inequities are present among NZ adults and children as young as 3-4 years. We do not yet know if these inequities are

present in infancy. We also have limited knowledge of the socio-ecological factors associated with infant sleep, and which infant sleep variables characterize a perceived sleep problem. This study aims to 1) characterize and compare the sleep of 12-week-old infants of Māori and non-Māori NZ women; 2) identify socio-ecological factors associated with infant sleep characteristics; and 3) determine features of infant sleep that contribute to a mother-perceived infant sleep problem.

Methods

Moe Kura: Mother and Child Sleep and Wellbeing in Aotearoa New Zealand *(Moe Kura)* is a longitudinal study investigating the role of sleep in the health and wellbeing of mothers and their children in NZ (Signal et al., 2022). The study followed mothers from late pregnancy to 3 years post birth and collected self-report questionnaire data at four points. The current research involved cross-sectional, secondary analyses of a subset of survey data collected at 12 weeks postpartum from 2010-2012.

All aspects of the study are informed by Kaupapa Māori research principles described in detail elsewhere (Signal et al., 2022) but briefly include: (1) Māori participation and control at all levels and stages of the research; (2) appropriate collection of ethnicity data to identify and monitor health disparities; and (3) equal explanatory and analytical power for Māori and non-Māori. This research is covered by the study's ethical approval (HDEC; CEN 09/09/070).

5.1.1.1 Variables

Sleep Measures. Infant sleep variables were developed from multi-choice questionnaire items based on the original Brief Infant Sleep Questionnaire (Sadeh, 2004) (see supplementary materials for sleep variable development details). Questions on night waking used the 10pm – 6am timeframe proposed by Henderson et al. (2011). Based on response distributions, most outcome variables were subsequently dichotomized *(Bedsharing, Room-sharing* and *Independent sleeping* all Yes/No; *Night LSRSP:* ≤ 4 hr vs. > 4 hr*; Night Location Change:* ≥ 1 time/week vs. never*; Opportunity for maternal daytime breaks:* 0-3 vs. 4-7 days/week*;* opportunities for reasonable

maternal sleep *(Reasonable mat. Sleep):* 0-3 vs. 4-7 days/week; Infant has help from others to go to sleep *(Help to sleep)*: often/always vs. rarely/never; *Day to Day Change* or *Consistency* in Infant Sleep Patterns: always different/frequent change vs. occasional change/always the same); *Sleep Problem:* Yes (serious or small) vs. No (not a problem at all). Due to their response distributions, two variables were coded into 4 categories: *Night Waking* (0, 1, 2, 3+ wakings) and *Daytime LSRSP* (< 1, 1-2, 2-3, >3 hours).

Maternal sleep duration was measured by a single item asking mothers to provide a past week estimate: "How many hours sleep, including naps, do you usually get in 24 hours?". Maternal sleep quality was measured with the Sleep Quality Subscale of the General Sleep Disturbance Scale (Lee, 1992), with the total score prepared as a continuous variable.

Maternal Ethnicity. Participating mothers self-identified their own ethnicity based on responses to the 2001 New Zealand Census question: *"Which ethnic group do you belong to? Mark the space or spaces which apply to you".* Participants were categorized as Māori if they identified as Māori alone or in combination with another ethnic group(s), with all others categorized as non-Māori (Stats NZ, 2019a).

Covariates. SEP was measured at 12 weeks postpartum using the New Zealand Index of Deprivation (NZDep2006; Salmond et al., 2007). This is a widely used area-based measure of relative socioeconomic deprivation in NZ based on nine census variables, with higher deciles indicating greater deprivation. Consistent with other research (Vaipuna et al., 2018), these deciles were collapsed into three levels of socioeconomic deprivation: low (deciles 1-3), medium (deciles 4-7), and high (deciles 8-10). Other covariates included maternal age (years), parity (primiparous or multiparous), infant age (weeks), infant ethnicity (Māori or non-Māori, as identified by the mother), breastfeeding status (exclusive breastfeeding, i.e.,, infants who had only ever received breastmilk versus all others). The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, et al., 1987) was used to measure current symptoms of maternal depression, with the total score

prepared as a continuous variable. Life stress was measured with the Life Stress scale from the Pregnancy Risk Assessment Monitoring System (PRAMS; Shulman et al., 2018) High stress was defined as ≥2 stressors, in line with prior studies (Ladyman et al., 2021; Signal et al., 2017). Partner relationship satisfaction was measured on an 8-point Likert-type scale (range 0-7; where, consistent with Ladyman et al. (2021), < 3 indicated greater satisfaction and ≥ 3 indicated less satisfaction or not applicable. Work status was measured with a single item asking if the participant currently works for *pay, profit or income.* Responses were *No; Yes, one paid job;* or *Yes, more than one paid job;* dichotomized to No/Yes.

5.1.1.2 Data Analysis

Analyses were conducted using IBM SPSS (Version 28).

Descriptive analyses. Bivariate associations with infant and maternal age were analysed using independent t-Tests; Chi-Square tests were used for all other categorical variables.

Multivariable analyses. The relative impact of different socio-ecological factors on sleep outcome variables were assessed with multivariable logistic regression models. Ordinal logistic regression was used for *Night Waking* and *Daytime LSRSP. Bedsharing* (nighttime bedsharing vs. all other night sleep locations) was examined as both an outcome variable (what factors are associated with bedsharing?) and a co-variate (is bedsharing associated with other sleep outcomes?). Independent variables were consistent across all models, except for the 'Sleep Problem' model, which included infant sleep outcomes as independent variables and additional variables pertaining to maternal sleep (duration and quality).

Results

Table 5.1 details sample demographics and infant sleep characteristics by maternal ethnicity.

5.1.1.3 Sample Demographics

Māori mothers were younger, with a greater proportion living in more deprived areas, compared to non-Māori mothers. Infant age ranged from 6-22 weeks; however, the standard deviation was relatively small (1.3 and 0.97 weeks for Māori and non-Māori, respectively), indicating more than 90% of mothers completed the survey within the requested timeframe (when infants were 11-13 weeks old). There was no difference in infant age based on maternal ethnicity. Most infants belonged to the same ethnic group as their mothers, however, 3.4% of Māori mothers had non-Māori infants, and 8.3% of non-Māori mothers had Māori infants.

5.1.1.4 Sleep Location

At night, both room-sharing and bedsharing was more common among Māori than non-Māori mothers. Non-Māori mothers were more likely to report independent (i.e., own room) infant sleep, and they were also more likely to report never changing their infant's sleep location overnight. During the day, approximately three quarters of infants slept in a cot or bassinet, this did not differ by ethnicity. Conversely, ethnic differences were seen in other day sleep locations and surfaces.

5.1.1.5 Infant Sleep Patterns

Nearly half of mothers reported their infants woke once between 10pm and 6am (Māori (M) 46.5%, non-Māori (nM) 45.9%), around one quarter reported waking twice, 16% reported no wakings, and 8%-10% reported ≥ 3 wakings. Most mothers reported nighttime LSRSP greater than 4 hr (M 85.9%, nM 87.4%). There were no differences in number of night wakings or night LSRSP by ethnicity. However, Māori mothers were more likely to report longer (> 3 hr) daytime LSRSP, and non-Māori mothers were more likely to report shorter daytime LSRSPs (< 1 hr and 1-2 hr).

Table 5.1: *Sample demographic and descriptive data on infant sleep location and patterns by maternal ethnicity*

	Māori	non-Māori	p
Demographic characteristics			
Sample n (%)	383 (35.3)	702 (64.7)	
Maternal age *years*, mean (SD, range)[a]	28.41 (6.32, 16-43)	32.08 (5.21, 16-46)	**< .001**
Infant age *weeks*, mean (SD, range)[a]	12.09 (1.3, 6-22)	12.17 (0.97, 9-21)	.345
Infant ethnicity, % (95% CI)			**< .001**
Māori	96.6 (94.4-98.1)	8.3 (6.4-10.5)	
non-Māori	3.4 (1.9-5.6)	91.7 (89.5-93.6)	
NZDep Level, % (95% CI)			**< .001**
Low (1-3)	15.2 (11.9-19.1)	39.7 (36.1-43.3)	
Medium (4-7)	38.8 (34.1-43.8)	42.7 (39.0-46.3)	
High (8-10)	45.9 (41.0-51.0)	17.7 (15.0-20.6)	
Infant sleep characteristics, % (95% CI)			
Night sleep location			
Room-sharing	66.1 (61.2-70.7)	48.3 (44.6-52.0)	**< .001**
Bedsharing	14.4 (11.1-18.1)	5.4 (3.9-7.3)	**< .001**
Independent sleep (own room)	19.8 (16.1-24.1)	42.2 (38.6-45.8)	**< .001**
In sibling or other room, in cot or bassinet	2.1 (1.0-3.9)	0.9 (0.4-1.8)	.085
Other	1 (0.4-2.5)	0.9 (0.4-1.8)	.755
Day sleep location (room)			
Parent Room	47.9 (42.9-52.9)	32.5 (29.1-36.0)	**< .001**
Own room	21.7 (17.8-26.1)	39.6 (36.0-43.3)	**< .001**
Sibling or other's room	0.5 (0.1-1.7)	0.4 (0.1-1.1)	.814
Another room of the house	18.0 (14.4-22.1)	9.3 (7.3-11.6)	**< .001**
With mum or another person (e.g., Being held, sling)	13.2 (10.1-16.9)	9.0 (7.0-11.3)	**.029**
Moving around with mum (e.g., In pram or basket)	18.0 (14.4-22.1)	17.5 (14.8-20.5)	.848
Day sleep location (sleep surface)			
Bassinet or cot	72.6 (68.0-76.9)	73.6 (70.3-76.8)	.706
Parent Bed	11.3 (8.4-14.8)	3.1 (2.0-4.6)	**< .001**
Infant seat	5.8 (3.8-8.5)	4.8 (3.4-6.6)	.502
Held	8.7 (6.2-11.8)	8.8 (6.9-11.1)	.935
Pram	8.2 (5.7-11.2)	12.7 (10.4-15.3)	**.024**
Other	13.6 (10.4-17.3)	11.4 (9.2-13.9)	.294
Night sleep location change (nights/week)			**< .001**
0 (never)	63.7 (58.8-68.4)	77.6 (74.4-80.6)	
1-3 nights	20.4 (16.6-24.6)	12.1 (9.9-14.7)	
4-6 nights	8.6 (6.1-11.7)	3.3 (2.1-4.8)	
7 (every night)	7.5 (5.0-10.2)	7.0 (5.3-9.0)	
Help to sleep			**.002**
Never	6.0 (4.0-8.8)	12.2 (9.9-14.7)	
Rarely	38.6 (33.8-43.5)	41.6 (38.0-45.3)	
Often	41.5 (36.6-46.5)	33.0 (29.6-36.6)	
Always	13.9 (10.7-17.7)	13.2 (10.8-15.8)	
Night waking (wakings/night)			.703
0	16.4 (13.0-20.4)	16.4 (13.8-19.3)	
1	46.5 (41.5-51.5)	45.9 (42.2-49.6)	
2	26.9 (22.6-31.5)	29.3 (26.1-32.8)	
≥3	10.2 (7.5-13.5)	8.4 (6.5-10.6)	
Night LSRSP			.227
< 2 hr	0.8 (0.2-2.1)	0.1 (0.0-0.7)	
2-4 hr	13.3 (10.2-17.0)	12.4 (10.1-15.0)	
> 4 hr	85.9 (82.2-89.1)	87.4 (84.8-89.7)	
Day LSRSP			**< .001**
< 1hr	5.7 (3.7-8.4)	11.3 (9.1-13.7)	
1-2 hr	26.6 (22.4-31.2)	35.0 (31.6-38.6)	
2-3 hr	34.5 (29.8-39.3)	34.5 (31.0-38.0)	
> 3 hr	33.2 (28.6-38.0)	19.2 (16.4-22.3)	
Reasonable mat. sleep (days/week)			.084
0 (never)	3.7 (2.1-5.9)	4.3 (3.0-6.0)	
1-3 days	19.6 (15.8-23.8)	13.8 (11.4-16.5)	
4-6 days	45.2 (40.2-50.2)	46.2 (42.6-49.9)	

	Māori	non-Māori	p
7 (always)	31.6 (27.1-36.4)	35.7 (32.2-39.3)	
Opportunity for mat. daytime breaks (days/week)			**.022**
0 (never)	2.9 (1.5-4.9)	7.0 (5.4-9.2)	
1-3 days	24.6 (20.5-29.1)	24.5 (21.5-27.8)	
4-6 days	33.0 (28.4-37.8)	33.7 (30.2-37.2)	
7 (always)	39.5 (34.7-44.5)	34.7 (31.2-38.2)	
Day-to-day change/Consistency			**.001**
Always the same	10.2 (7.5-13.5)	5.7 (4.2-7.6)	
Change occasionally	62.6 (57.6-67.3)	54.0 (50.3-57.7)	
Change often	18.8 (15.2-23.0)	29.3 (26.0-32.7)	
Every day is different	8.4 (5.9-11.5)	11.0 (8.8-13.5)	
Perceived problem, *n* (%)	18.0 (14.4-22.1)	26.1 (22.9-29.4)	**.003**

[a] Analysed with T-test, all others with Chi-square test
Abbreviations: LSRSP, longest self-regulated sleep period; Mat., maternal; NZDep, New Zealand Deprivation Index.

5.1.1.6 Mothers' Experiences of Infant Sleep

Most mothers reported their infants' sleep allowed them a reasonable amount of sleep on 4 or more days/week, which did not differ by ethnicity. However, non-Māori mothers were more likely to report their infants' daytime sleep patterns never allowed them to take a break (M 2.9% vs. nM 7.0%,). A large majority (> 90%) of mothers reported at least occasional day-to-day change in their infants' sleep patterns, though Māori mothers were more likely to report day-to-day consistency. Māori mothers were also more likely to report their infants "often" went to sleep with help from others and were less likely to rate their infants' sleep as problematic (M 18.0% vs. nM 26.1%).

5.1.1.7 Factors Associated with Infant Sleep Characteristics

Tables 5.2 and 5.3 present results from multivariable logistic models on the factors associated with infant sleep characteristics. After controlling for covariates, maternal ethnicity remained associated with infant sleep location. Ethnicity was not independently associated with key measures of infant sleep development, including night waking, nighttime LSRSP, night sleep location change, or the infant having help from others to go to sleep. Higher deprivation was associated with higher odds of bedsharing and room-sharing, and lower odds of independent sleep, but was not associated with developmental markers of sleep.

Factors associated with increased odds of night waking were older maternal age, more maternal depression symptoms, exclusive breastfeeding, having returned to work, and bedsharing. Factors associated with shorter nighttime LSRSP were maternal depression symptoms, and bedsharing.

The relationship between sleep location and breastfeeding status appeared to change with changes to nighttime mother-infant proximity, with a positive association between bedsharing and breastfeeding (OR 1.82, $p = 0.012$), no association between room-sharing and breastfeeding, and a negative association between independent infant sleep and breastfeeding (OR 0.66, $p = .003$).

Table 5.2 *Socio-ecological factors associated with infant night sleep location and patterns*

	Bedsharing	Room-sharing	Independent sleep	Night wakings[a]	Night LSRSP < 4h	Night loc. change
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Mat. Ethnicity (Māori)	1.945 (1.186-3.190)**	1.591 (1.176-2.153)**	0.472 (0.336-0.662)***	1.004 (0.763-1.322)	0.943 (0.600-1.483)	1.386 (0.998-1.925)
Mat. Age	0.987 (0.946-1.030)	0.993 (0.968-1.018)	0.999 (0.972-1.026)	1.036 (1.013-1.060)**	1.007 (0.970-1.045)	0.99 (0.963-1.0170)
Infant Age	1.178 (1.025-1.355)*	0.937 (0.848-1.035)	1.025 (0.921-1.141)	0.988 (0.904-1.081)	0.962 (0.829-1.116)	1.031 (0.927-1.147)
NZDep (ref: Low, 0-3)						
Med (4-7)	1.721 (0.916-3.234)	1.136 (0.841-1.534)	0.927 (0.679-1.265)	0.904 (0.687-1.189)	0.839 (0.524-1.343)	0.890 (0.622-1.273)
High (8-10)	2.433 (1.255-4.715)**	1.719 (1.193-2.477)**	0.477 (0.318-0.715)***	1.243 (0.890-1.736)	1.105 (0.650-1.877)	1.099 (0.731-1.652)
Parity (Multip)	1.086 (0.679-1.736)	1.394 (1.070-1.815)*	0.691 (0.521-0.916)*	0.803 (0.632-1.019)	0.944 (0.632-1.410)	1.456 (1.077-1.969)*
EPDS	1.059 (1.008-1.112)*	0.995 (0.965-1.027)	0.968 (0.935-1.002)	1.053 (1.024-1.083)***	1.064 (1.019-1.111)**	1.011 (0.977-1.046)
Relationship (greater satisfaction)	0.850 (0.520-1.388)	0.637 (0.474-0.856)**	1.609 (1.162-2.228)**	1.024 (0.787-1.332)	0.966 (0.625-1.491)	0.715 (0.519-0.983)*
Life Stress	1.187 (0.727-1.937)	0.967 (0.729-1.283)	0.894 (0.66-1.211)	1.063 (0.823-1.374)	0.971 (0.633-1.491)	1.442 (1.051-1.978)*
Breastfed (excl.)	1.821 (1.141-2.906)*	1.143 (0.882-1.480)	0.659 (0.500-0.869)**	1.396 (1.102-1.768)**	1.106 (0.747-1.637)	0.832 (0.620-1.115)
Working	1.585 (0.821-3.062)	0.891 (0.578-1.375)	0.859 (0.532-1.387)	1.635 (1.096-2.438)*	1.107 (0.592-2.070)	1.800 (1.145-2.831)*
Bedsharing				3.562 (2.331-5.444)***	3.299 (1.956-5.562)***	2.383 (1.502-3.782)***

[a] Night Wakings analysed with ordinal logistic regression, all other others with binary logistic regression
Abbreviations: EDPS, Edinburgh Postnatal Depression Scale; excl., exclusive; LSRSP, longest self-regulated sleep period; Mat., maternal; multip, multiparous; NZDep, New Zealand Deprivation Index.
*$p < .05$, **$p < .01$, ***$p < .001$

Table 5.3: *Socio-ecological factors associated with infant day sleep location and patterns, and the maternal experience of infant sleep*

	Shorter daytime LSRSP[a]	Daytime mat. break	Reasonable mat. sleep	Help to sleep	Consistency
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Mat. Ethnicity (Māori)	0.588 (0.448-0.773)***	0.747 (0.536-1.040)	1.251 (0.862-1.817)	1.201 (0.892-1.617)	0.637 (0.463-0.876)**
Mat. Age	1.020 (0.998-1.042)	0.995 (0.969-1.022)	1.026 (0.995-1.059)	0.99 (0.966-1.015)	1.04 (1.013-1.067)**
Infant Age	1.061 (0.974-1.155)	0.944 (0.846-1.052)	0.990 (0.876-1.120)	0.959 (0.871-1.056)	0.945 (0.85-1.050)
NZDep (ref: Low, 0-3)					
Med (4-7)	1.020 (0.780-1.334)	0.907 (0.655-1.256)	0.769 (0.521-1.137)	1.050 (0.778-1.417)	1.011 (0.741-1.379)
High (8-10)	0.802 (0.580-1.108)	0.753 (0.506-1.121)	1.031 (0.660-1.611)	1.362 (0.951-1.952)	0.964 (0.661-1.406)
Parity (Multip)	0.585 (0.462-0.741)***	1.112 (0.836-1.480)	1.304 (0.933-1.824)	0.835 (0.643-1.083)	0.912 (0.695-1.199)
EPDS	1.032 (1.004-1.061)*	1.084 (1.049-1.120)***	1.117 (1.077-1.158)***	1.024 (0.993-1.056)	1.031 (0.998-1.064)
Relationship (greater satisfaction)	1.128 (0.869-1.464)	0.886 (0.648-1.210)	0.903 (0.633-1.289)	1.250 (0.935-1.671)	0.674 (0.498-0.910)*
Life Stress	1.240 (0.965-1.593)	1.027 (0.756-1.395)	1.115 (0.782-1.591)	1.254 (0.95-1.656)	1.055 (0.787-1.413)
Breastfed (excl.)	0.971 (0.773-1.220)	0.969 (0.733-1.281)	1.050 (0.757-1.456)	1.024 (0.794-1.322)	1.230 (0.941-1.608)
Working	1.141 (0.782-1.665)	0.826 (0.510-1.338)	1.142 (0.679-1.921)	1.193 (0.776-1.832)	0.769 (0.483-1.224)
Bedsharing	1.073 (0.709-1.623)	2.169 (1.369-3.435)**	1.396 (0.832-2.343)	1.807 (1.138-2.872)*	1.012 (0.629-1.627)

[a] Daytime LSRSP analysed with ordinal logistic regression, all other others with binary logistic regression
Abbreviations: EDPS, Edinburgh Postnatal Depression Scale; excl., exclusive; LSRSP, longest self-regulated sleep period; Mat., maternal; multip, multiparous; NZDep, New Zealand Deprivation Index
*$p < .05$, **$p < .01$, ***$p < .001$

5.1.1.8 Characterising Perceived Sleep Problems

As presented in Table 5.4, factors associated with decreased odds of a perceived sleep problem were multiparity, greater relationship satisfaction, higher life stress, being in paid employment, and bedsharing. Conversely, factors associated with increased odds of perceived problematic sleep included more maternal depression symptoms and fewer maternal opportunities for sleep and rest.

There was a dose-response relationship between night waking and perceived problem sleep; compared to mothers whose infants did not wake between 10pm and 6am, mothers whose infants woke once were no more likely to rate their infant's sleep as problematic, while mothers whose infants woke twice had approximately 2x increased odds, and those whose infants woke three or more times had more than 4.5x increased odds. Daytime LSRSP < 1 hr was associated with a perceived sleep problem, but night LSRSP was not.

Neither maternal sleep duration nor quality were associated with a perceived infant sleep problem, however measures that aimed to capture the maternal experience of infant sleep (*Fewer maternal opportunities for daytime breaks;* infant receives *help to sleep; day to day change* in infant sleep patterns*)* were each associated with more than 2x increased odds of a perceived sleep problem.

Table 5.4: *Infant sleep and socio-ecological factors associated with perceived infant sleep problem*

	p	OR (95% CI)
Maternal ethnicity (Māori)	.538	0.873 (0.566-1.345)
Maternal age	.398	1.016 (0.980-1.053)
Infant age	.287	0.917 (0.782-1.076)
NZDep *(ref: Low, 0-3)*		
Med (4-7)	.676	0.915 (0.605-1.386)
High (8-10)	.218	0.723 (0.431-1.212)
Parity (Multip)	**<.001**	**0.461 (0.314-0.677)**
EPDS	**.001**	**1.077 (1.030-1.126)**
Relationship (greater satisfaction)	**.015**	**0.599 (0.397-0.904)**
Life stress	**.019**	**0.615 (0.410-0.922)**
Breastfed (excl.)	.381	0.850 (0.591-1.222)
Working	**.012**	**0.419 (0.213-0.824)**
Bedsharing	**.010**	**0.420 (0.217-0.812)**
Maternal sleep duration	.853	0.987 (0.856-1.137)
Maternal sleep quality	.305	1.082 (0.931-1.257)
Night wakings *(ref: 0 Wakings)*		
1 waking	.968	0.988 (0.538-1.815)
2 wakings	**.029**	**2.067 (1.078-3.965)**
≥ 3 wakings	**.001**	**4.460 (1.894-10.503)**
Night LSRSP ≤ 4 hr	.470	0.807 (0.450-1.445)
Night sleep location change	.599	1.116 (0.742-1.679)
Day LSRSP *(ref: > 3 hr)*		
2-3 hr	.760	0.920 (0.538-1.572)
1-2 hr	.165	1.450 (0.858-2.450)
< 1 hr	**.045**	**1.986 (1.015-3.884)**
Daytime break opportunities (< half the week)	**<.001**	**2.640 (1.806-3.860)**
Reasonable maternal sleep (< half the week)	**.001**	**2.226 (1.414-3.505)**
Infant has help to sleep (often/always)	**<.001**	**2.290 (1.581-3.315)**
Day to day change (always/frequent)	**<.001**	**2.477 (1.725-3.557)**

Note: Bold text highlights statistically significant associations, as indicated by the *p*-values.
Abbreviations: EDPS, Edinburgh Postnatal Depression Scale; excl., exclusive; LSRSP, longest self-regulated sleep period; Mat., maternal; multip, multiparous; NZDep, New Zealand Deprivation Index

Discussion

This study described and compared the sleep of infants of Māori and non-Māori NZ mothers at approximately 12 weeks of age. It also drew on socio-ecological models of sleep health to explore factors associated with different sleep locations and patterns and characterized maternal perceived infant sleep problems at this young age. Consistent with established literature, we found sleep at 12-weeks to be highly variable (Galland et al., 2012; Jenni & Carskadon, 2012). The infants of Māori and non-Māori mothers differed somewhat in *where* but less in *how* they were sleeping. A variety of factors were associated with perceived problems, and these did not always align with commonly accepted markers of sleep development.

A review of normal sleep patterns in infants and children found infants woke on average 0.8 times per night at 3-6 months and exhibited a mean longest sleep period of 5.7 hr at 0-5 months, though data varied widely – particularly for night waking (Galland et al., 2012). Broadly in line with this, our findings showed almost half of Māori and non-Māori mothers reported one night waking, more than one quarter reported two wakings, and approximately 9% reported their infants woke three or more times, while approximately 16% reported their infants slept through the night. More than 85% of both groups reported night LSRSPs longer than 4 hours. We found no evidence of ethnic inequities in key developmental aspects of sleep at 12 weeks; night waking and night LSRSP. These findings add to prior research to suggest sleep health inequities emerge somewhere between 3 months and 3 years as a result of exposure to ethnic inequities in social determinants of health (Galland et al., 2012; Paine & Muller, 2023).

According to both the American Academy of Paediatrics and the NZ Ministry of Health, room-sharing on a separate, flat sleep surface is recommended as the safest sleep location for infants under 6 months, to avoid sleep-related infant deaths (Ministry of Health, 2022; Moon et al., 2022). Māori mothers were more likely to report room-sharing, in line with recommendations. Both

groups also reported sleep practices inconsistent with recommendations; Māori mothers were more likely to report bedsharing, and non-Māori mothers were more likely to report their infants slept independently, in their own bedrooms. These findings were broadly consistent with prior work on infant sleep practices in NZ (Scragg et al., 1996; Tipene-Leach et al., 2010). This study was novel in the level of detail it provided on day sleep location and patterns at 12 weeks, which were found to be particularly variable.

Our rates of room-sharing are ostensibly positive, and yet should be considered in light of a range of potential drivers. In addition to higher rates of room-sharing among Māori, room-sharing was more common among dyads in the high deprivation category. Research indicates people who live in more deprived areas are more likely to live in overcrowded, underheated homes; factors that might contribute to both room- and bedsharing rates (Tipene-Leach & Fidow, 2022; Wennergren et al., 2021; Wilson et al., 2014). It is well known that Māori are over-represented in the most deprived neighbourhoods of NZ, and so our findings may reflect, at least in part, the inequitable distribution of SEP by ethnicity. Marginalized groups have fewer structural opportunities for sleep-supporting practices (Muller, Paine, et al., 2022; Reid et al., 2019), and the recommended practice of room-sharing may not always confer the intended safety benefits in this context. For example, one study found room-sharing was associated both with lower SEP, and higher rates of overnight transitions to bedsharing, against recommendations (Paul et al., 2017). Conversely, other studies report no relationship between SEP and sleep location, and find bedsharing to be an increasingly common practice returning to Western culture, largely to facilitate the recommended practice of breastfeeding (Blair & Ball, 2004; Wennergren et al., 2021). Together, these findings highlight the need for nuanced explorations of infant sleep practices in future research (Blair & Ball, 2004; Paul et al., 2017; Wennergren et al., 2021). Findings from such work could help to address structural barriers to safe sleep while supporting families to navigate their unique sleep preferences alongside risk-reduction recommendations and available resources.

Consistent with current literature, mother-infant proximity at nighttime was also associated with breastfeeding (Baddock et al., 2019; Blair & Ball, 2004; Wennergren et al., 2021). We found bedsharing infants had increased odds of breastfeeding and, conversely, independent sleeping infants had decreased odds. Also in line with socio-ecological models, maternal depressive symptoms were associated with more night waking, shorter night- and day LSRSP, and fewer opportunities for reasonable maternal sleep. Directionality cannot be determined in this cross-sectional study, but research suggests the relationship between maternal depression and infant sleep is bi-directional (Sadeh et al., 2010).

We found a dose-response relationship between night waking and a perceived infant sleep problem, underscoring the salience of night waking in parents' perceptions of infant sleep (Henderson et al., 2013; Mindell et al., 2022; Sadeh et al., 2011). One waking (versus none) showed no effect, suggesting some night waking is expected in early infancy (Ball, 2013; Barry, 2021a). Conversely, two wakings was associated with a two-fold increase in a perceived problem, and three plus with a more than four-fold increase. These results are striking given we found that at 12 weeks, infants are more likely to wake twice than not at all. They point to a tension between what is normative for infants and what is expected and/or manageable for caregivers. Eagerness among mothers to ease this tension is evident in participant feedback from intervention studies aimed at supporting sleep in early infancy (Ball et al., 2018; Sweeney et al., 2020). In addition to night waking, the association between a perceived sleep problem and infants receiving more help settling to sleep is consistent with prior research (Bayer et al., 2007; Loutzenhiser et al., 2011). Contrary to established findings (Henderson et al., 2013; Mindell et al., 2022; Sadeh et al., 2011), night LSRSP was not associated with a perceived problem in the current study, perhaps due to a ceiling effect in our LSRSP variable.

Our study highlights the pertinence of day sleep, with short daytime LSRSP, more day-to-day change in sleep patterns, and fewer opportunities for daytime breaks all associated with a

perceived sleep problem. This aligns with research that indicates issues with napping is the most frequently reported sleep concern by caregivers of infants (Mindell et al., 2022). Our somewhat surprising finding that mothers who had returned to work were less likely to perceive a sleep problem might be explained by a reduced sensitivity to nap difficulties in this group. Consistent with this idea, one study showed that while mothers reported similar levels of stress regardless of work status, stress levels were more tightly linked to infant sleep disturbances among mothers on parental leave, compared to those working outside the home (Sinai & Tikotzky, 2012).

Research suggests infant sleep patterns that cause more parental sleep disturbance are more likely to be perceived as problematic, particularly in Western culture (Mindell et al., 2015). We found an association between a perceived problem and mothers' subjective judgements of whether their infants' sleep patterns afforded mothers reasonable sleep, but not with self-reported maternal sleep duration, nor quality. Individual differences in sleep needs and adaptability may affect how mothers experience infant-related sleep disturbances (Dongen et al., 2004; Fjell & Walhovd, 2024).

Several socio-ecological variables were associated with a perceived infant sleep problem, including maternal depression symptoms, life stress, and relationship satisfaction. These findings support a recently proposed model by D'Souza and Cassels (2023) that emphasizes the role of contextual factors in parents' perceptions of their children's sleep. Similar to other findings (Loutzenhiser et al., 2011), bedsharing was not associated with a perceived sleep problem, despite its association with common Western indices of poorer sleep development (Henderson et al., 2013; Mindell et al., 2022; Sadeh et al., 2011). Some authors suggest that mothers who choose to bedshare might have more realistic expectations of infant sleep (Ball, 2013; Barry, 2021a; D'Souza & Cassels, 2023). Others offer culture-based explanations; Latz et al. (1999) found bedsharing was associated with sleep problems among American but not Japanese infants. Alternatively, in the context of high deprivation, infant sleep might be evaluated less negatively relative to concurrent

challenges (Barry & McKenna, 2022). Indeed, we found high life stress was associated with decreased odds of a perceived sleep problem. Reasons for bedsharing were not assessed in the current study, and these tentative interpretations require empirical investigation.

Our findings have important clinical and public health implications. Large intra- and inter-infant variability in sleep patterns is expected in early infancy, and parents should be supported to anticipate and manage the significant challenge this brings. Support should include the provision of perinatal services that are fit for purpose. Research indicates fear of judgement from health providers prevents many mothers from disclosing their sleep practices and concerns (Clapham et al., 2024). This leads to the provision of insufficient or unsuitable care that ultimately perpetuates perceived problems and maternal distress (Clapham et al., 2024). It is critical that services are open and responsive to families' unique needs.

A key strength of this study lies in the Kaupapa Māori methodological approach of *Moe Kura* (Signal et al., 2022), which provided a sample broadly representative of the NZ mother-infant population with sufficient analytical power to explore Māori/non-Māori differences. Another strength was its inclusion of detailed day sleep data. Where most studies have focused primarily on night sleep, our findings indicate day sleep is more variable than night sleep and highly relevant to maternal perceptions of infant sleep. Finally, our study provides a strong basis for future research. The misalignment of normative sleep patterns with the characteristics of perceived problems requires further exploration. The relationship between maternal depression and child sleep also warrants further research. We found symptoms of maternal depression were associated with multiple domains of infant sleep, and perceived sleep problems. Elucidating potential mechanisms of transmission might point to interventions that can benefit maternal mental health and child sleep.

Study limitations include the cross-sectional design, which precludes causal inference, and the exclusive reliance on maternal self-reports during a challenging life stage. However, since parental

experiences of infant sleep often drive presentations to health services, our measures had good ecological validity. A related limitation is our exclusive focus on maternal experiences. This fits with the broader aims of the *Moe Kura* study but means our findings cannot be generalized to other caregiver-infant dyads. There were also limitations to some measures. Our sleep-surface multichoice options did not include wahakura (Indigenous flax basket) or Pēpi Pod (plastic bassinet); two in-bed, bassinet-like sleep devices often used in NZ, particularly among Māori (Tipene-Leach & Fidow, 2022). Bedsharing rates might have been overestimated if mothers selected the "parent-bed" option for wahakura or Pēpi Pod bassinets. However, it is reassuring that our bedsharing rates align with other NZ research (Galland et al., 2014). We did not assess reasons for bedsharing, which appear highly relevant to parental perceptions of infant sleep (D'Souza et al., 2023). We also had no suitable measure of infant temperament, so could not account for this aspect of infant regulation. Some studies have found infant temperament is related to infant sleep (Sorondo & Reeb-Sutherland, 2015), while others have not (Martini et al., 2017). Our measure of night LSRSP prevented analysis of LSRSP beyond the maximum response option of > 4 hr; including longer durations might have revealed more and/or stronger associations (Galland et al., 2012).

5.1.1.9 Conclusion

In line with prior research, we found infant sleep at ~12 weeks of age to be highly variable, particularly during the day. Infants of Māori and non-Māori mothers differed somewhat in *where* but less in *how* they were sleeping. No ethnic differences were found in key measures of sleep development: night waking and night LSRSP, indicating sleep-health inequities evident in prior research emerge somewhere between 3 months and 3 years, likely resulting from exposure to ethnic inequities in social determinants of health. Māori mothers were more likely to room- or bedshare with their infants, and the infants of non-Māori mothers were more likely to sleep independently. This study drew on socio-ecological models of infant sleep and found several

factors were related to different dimensions of infant sleep at ~12 weeks, and to maternal perceptions of an infant sleep problem. It finds several important associations that provide a strong basis for future research.

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CHAPTER 6 MATERNAL DEPRESSIVE SYMPTOMS IN AND BEYOND THE PERINATAL PERIOD: ASSOCIATIONS WITH INFANT AND PRESCHOOLER SLEEP

This second paper now considers one socio-ecological factor associated with child sleep identified in Study One: maternal depression. The focus is on prenatal depression as a potential predictor of subsequent, adverse sleep health outcomes in children, controlling for depression at other time points. Relationships between postnatal depression and maternal depression after the perinatal period are also explored. In addition to their areas of focus, there are two important methodological differences between these papers: First, where Study One looked cross-sectionally at data collected at 12-weeks postnatal, this paper looks at longitudinal relationships using data collected in pregnancy, 12-weeks postpartum, and 3-years post-birth. Second, this study includes maternal ethnicity as a key covariate in all analyses, rather than comparing the data of Māori and non-Māori mothers separately, as in parts of Study One. Note: Because this is a stand-alone manuscript, the Moe Kura data collection points are different to those noted in the introduction. T1 & T2 was re-labelled T1 (pregnancy at 35-37 weeks gestation), T4 re-labelled T2 (12-weeks postnatal), T5 re-labelled T3 (3-years post-birth).

6.1 Study Two

Carter, M. L., Paine, S-J., Sweeney, B. M., Taylor, J. E., & Signal, T. L. (in press). Maternal depressive symptoms in and beyond the perinatal period: Associations with infant and preschooler sleep. *Sleep*.

Abstract

Study Objectives. (1) To describe sleep in infancy and early childhood among children born to mothers with and without clinically significant depressive symptoms, and (2) to explore the relationships between maternal depressive symptoms and sleep patterns and problems during infancy and early childhood.

Methods. Secondary analysis of longitudinal data from the *Moe Kura: Mother and Child, Sleep and Wellbeing in Aotearoa/New Zealand* study. Data was collected in pregnancy (T1), 12 weeks postpartum (T2), and 3 years post-birth (T3). Participants were 262 Māori and 594 non-Māori mother-child dyads. Chi-square and independent t-tests measured bivariate associations between maternal mood (T1, T2, T3) and child sleep characteristics (T2, T3). Binary logistic regression models examined longitudinal and concurrent associations between maternal depressive symptoms and infant and preschooler sleep. Adjusted models accounted for key socio-demographic variables, as well as infant sleep variables in preschooler models.

Results. Bivariate associations were found between prior and concurrent depressive symptomology and many of the infant and preschooler sleep outcomes. In adjusted models, prenatal depressive symptoms remained independently associated with shorter-than-recommended sleep durations in preschoolers. In these models, concurrent depression was also associated with night waking, night LSRSP, and perceived sleep problems at 12 weeks postpartum, and CSHQ-determined and perceived sleep problems at 3 years post birth.

Conclusions. Longitudinal and cross-sectional associations were found between maternal depressive symptoms and child sleep. Sleep appears to be one pathway by which maternal depression confers risk for suboptimal child health outcomes. Findings support the need for earlier and better maternal mental health services.

Keywords: maternal mental health; depression; pregnancy; perinatal; child sleep; infants; preschoolers; sleep duration; sleep problems; health inequities

Statement of Significance. Maternal depression can have a deleterious effect on child wellbeing; child sleep is one potential mechanism by which risk is conferred. To our knowledge, this is the first study to explore longitudinal relationships between clinically significant prenatal depressive symptoms and child sleep in a large, socio-economically diverse sample with strong Indigenous representation. Findings indicate maternal depressive symptomology is associated with several child sleep outcomes in infancy and early childhood, including associations between prenatal depression and child sleep at 3-4 years. These findings highlight the need for population-based policies and interventions that support maternal mental health across and beyond the perinatal period.

Introduction

Perinatal depression can have enduring deleterious effects that reverberate through family members and across time (O'Donnell et al., 2014). Studies suggest exposure to perinatal maternal depression can predispose children to later emotional, cognitive, and behavioural difficulties (Baird et al., 2023; Deave et al., 2008; Glover, 2014; Junge et al., 2017). Identifying and understanding potential mechanisms of transmission can inform the type and timing of intervention required.

Sleep is one potential mechanism for which there is emerging evidence. Paediatric sleep health is integral to child development and sleep health is associated with a wide range of broader paediatric health outcomes (Meltzer et al., 2021). The transactional model of infant sleep development (Sadeh & Anders, 1993) posits that infant sleep problems develop through a complex interplay of physiological and psycho-social factors, which include maternal depression. Postnatally, maternal depression is associated with lower personal, household, and social

functioning (Posmontier, 2008), and may interfere with parent-infant interactions and caregiving activities, including sleep practices and routines (Field, 2010). However, there is evidence to suggest these processes begin in utero. Experimental animal studies indicate prenatal maternal distress is causally linked to sleep disturbance in offspring (Dugovic et al., 1999; Kennaway, 2002). One hypothesized mechanism, developed from animal studies, is that elevated exposure to glucocorticoids could disrupt development of the foetus' hypothalamic-pituitary-adrenal (HPA) axis and its diurnal pattern (Glover et al., 2010). Though undoubtably more complex, there is some evidence to suggest a corresponding mechanism in humans (Stein et al., 2014).

Irrespective of the specific pathway, higher levels of maternal depression appear to confer risk for subsequent infant sleep problems. Bat-Pitault et al. (Bat-Pitault et al., 2017) investigated the sleep architecture of newborn and six-month-old infants born to mothers diagnosed with major depressive disorder (MDD), compared to matched infants born to mothers with no history of depression (total n = 64). Polysomnography (PSG) comparisons showed group-based differences in sleep architecture at both time points. The infants of mothers with MDD diagnoses exhibited more disturbed sleep, lower total sleep time (TST), higher wake time, and lower sleep efficiency than their clinically- and demographically matched peers whose mothers had no depression history. These findings were in line with a similar study using actigraphy (n = 18) (Armitage et al., 2009). Though informative, these studies were limited in that infants in the 'maternal depression' groups were not necessarily exposed to depression in utero, as inclusion criteria allowed for historic and possibly remitted MDD diagnoses.

Studies using objective sleep measures are also limited by small sample sizes. Parent-report measures of infant sleep have enabled larger-scale studies of these posited links. In a study of 312 mother-infant dyads, Dias and Figueiredo (Dias & Figueiredo, 2021) reported maternal depressive symptoms during the third trimester of pregnancy predicted more unsettled sleep and more daytime sleepiness in infants at 3 and 6 months of age. Similarly, prenatal depression was

associated with long sleep onset latency and irregular sleep routines in 3-month-old infants (Morales-Munoz et al., 2018). However, these studies found several other aspects of infant sleep, including night-waking, showed no association with prenatal depression. Other studies fail to support the purported relationship entirely. Galbally et al. (2018) found neither maternal prenatal depression nor prenatal antidepressant use predicted later infant sleep outcomes. Further research into the maternal depression – infant sleep relationship is needed.

In addition to adding valuable evidence to the limited and mixed findings in current studies, it is important for research to consider the potential impact of maternal depression on child sleep beyond infancy. Across the first 3 years of life, sleep undergoes rapid development. Sleep/wake patterns change markedly in this period, and exhibit great variability (Borbély et al., 2016). A small number of studies have looked at the relationship between maternal prenatal depressive symptoms and sleep in older children, including two prospective cohort studies (O'Connor et al., 2007; Toffol et al., 2019). Toffol et al. (2019) found children of women with clinically significant depressive symptomology during pregnancy had shorter nocturnal sleep duration, longer sleep onset latency, higher odds of more frequent night waking, and higher odds of having a sleep disorder at age 3.5 years, compared to children of women with low symptomology during pregnancy. The study controlled for several obstetric and psychosocial covariates, and concurrent maternal depression at 3.5 years, but not for depressive symptoms during the postnatal period. O'Connor et al. (2007) looked at the impact of maternal prenatal anxiety and depression on child sleep at 18 months (n = 7,458) and 30 months (n = 6,829) after controlling for several obstetric and psychosocial covariates, as well as prenatal and postnatal depression, but not concurrent depression. Here, total sleep problems but not total sleep duration, nor night-wakings was associated with maternal mental distress during pregnancy.

An important limitation characterizing most research in this field is the predominance of white mothers in moderate – high socioeconomic positions (SEPs) in study samples. Indeed, in many

cases, ethnicity and/or SEP are not reported. In particular, Indigenous groups are not widely represented in this body of literature, which limits the ability of current findings to inform appropriate and effective prevention and intervention programs.

In sum, further research is needed to better elucidate the posited relationship between perinatal depression and child sleep over time, particularly research with extended timeframes and more diverse samples. The current study is guided by Kaupapa Māori research theory, an Indigenous research paradigm that is responsive to Māori needs and committed to providing outcomes that are useful to Māori, the Indigenous peoples of Aotearoa New Zealand (NZ) (Paine & Gander, 2013; Pihama et al., 2002; Signal et al., 2022). Māori represent approximately 30% of the current sample and the SEP distribution of the sample is broadly representative of Māori and non-Māori populations in NZ. Here, secondary analysis of the *Moe Kura: Mother and Child, Sleep and Wellbeing in Aotearoa/New Zealand* dataset *(Moe Kura)* was used to 1) report sleep characteristics during infancy and early childhood of children born to mothers with and without clinically significant depressive symptomology at three time points (third trimester of pregnancy, 12 weeks postnatal, and 3 years post-birth); and 2) explore maternal perinatal depressive symptomology as a predictor of sleep patterns and problems during infancy and early childhood, controlling for maternal depressive symptoms at subsequent time points.

Methods

This research was part of *Moe Kura*, a longitudinal, observational, cohort study exploring the role of sleep in the health and wellbeing of Māori and non-Māori mothers and their children in NZ. The study followed mother-child dyads from pregnancy until the *Moe Kura* children were approximately 3 years old, with four survey-based data collection waves between October 2009 and April 2015 (see Signal et al. (2022) for a detailed description of the recruitment process). Guided by Kaupapa Māori epidemiological methodology, three key principles underpin *Moe Kura*: (1) Māori participation and control at all levels and stages of the research; (2) appropriate

collection of ethnicity data to identify and monitor health disparities; and (3) equal explanatory and analytical power for Māori and non-Māori. These principles and the broader methodological approach are explained more thoroughly elsewhere (Paine et al., 2013; Signal et al., 2022). The current research used data from 35-37 weeks' gestation (T1), 12 weeks postnatal (T2) and 3 years post-birth (T3) and is covered by the study's ethical approval (HDEC; CEN 09/09/070).

6.1.1.1 Measures

Maternal and child demographics. Participating mothers self-identified their own and their children's ethnicity in a question taken from the NZ Census: *"Which ethnic group do you [does your child] belong to? Mark the space or spaces that apply to you [your child]".* Participants were categorized as Māori if they marked 'Māori' alone or with (an)other ethnic group(s), and everyone else was categorized as non-Māori (Ministry of Health, 2004). Maternal ethnicity was measured at T1 and child ethnicity was measured at T2.

SEP was measured at T1 with the New Zealand Index of Deprivation (NZDep2006). NZDep is a widely used area-based measure of socioeconomic deprivation in NZ; it uses nine census variables to estimate the level of material deprivation for people, based on home address, in each small area. Each area is assigned a decile from 1 (least deprived) to 10 (most deprived). Consistent with other research (e.g. Vaipuna et al., 2018), these deciles were collapsed into three levels of socioeconomic deprivation: low (deciles 1-3), medium (deciles 4-7), and high (deciles 8-10).

Other demographic measures were maternal age (years), parity at T1 (nulliparous or multiparous), whether the mother was caring for child(ren) younger than the *Moe Kura* child at T3 (yes/no), child age (gestational weeks at T1, weeks at T2, years at T3), child sex, and child gestational age at birth (weeks).

Maternal depressive symptoms. Maternal depressive symptoms at T1 and T2 were measured with the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, et al., 1987). The EPDS is a

widely used screening tool that assesses common symptoms of depression in the pre- and postnatal periods (Cox et al., 1996; Kozinszky & Dudas, 2015). The EPDS is comprised of 10 items scored on a 4-point Likert-type scale. Possible scores range from 0-30, with higher scores indicating more distress. Scores of 13 or more are considered clinically significant (Cox, Holdenand, et al., 1987; Levis et al., 2020). At 3-years post-birth (T3), the EPDS was not considered an appropriate measure. Instead, depressive symptoms at T3 were measured with the Kessler 10 Item Scale (K-10; Andrews & Slade, 2001; Kessler et al., 2002). A common measure of depressive symptoms, the K-10 can be used to assess symptomatology in the past month. The K-10 was developed for use in the annual U.S. National Health Survey (Andrews & Slade, 2001) and has been used in NZ national surveys since 2003/2004 (Browne et al., 2010). Possible scores range from 0-40, with higher scores indicating more distress. Scores of 12 or more are considered clinically significant (Browne et al., 2010). For the purposes of this study, some analyses are reported using mothers' scores on the EPDS and K-10 (a continuous variable indicating the extent of depressive symptoms), whereas other analyses dichotomized mothers' scores into categories based on whether clinically significant depressive symptomology was present (≥ 13 EPDS, ≥ 12 K-10), or absent (scores < 13 EPDS, < 12 on K-10).

Child sleep. A range of sleep variables were selected to reflect the multi-faceted nature of paediatric sleep health, and the complex physiological and psycho-social pathways by which depression may influence its development.

Infant sleep variables (T2) were night waking, longest continuous self-regulated sleep period (LSRSP) at night and during the day, and maternally perceived sleep problem. Each was assessed with a single multi-choice questionnaire item and subsequently dichotomized based on relationships seen with parent reports of problematic sleep (Carter et al., in press), and National Sleep Foundation (NSF) guidelines (Hirshkowitz et al., 2015). *Night waking* was assessed with the question "how many times does your baby usually wake up between 10pm and 6am?" Response

options were "0/not at all, 1, 2, 3, 4 or more times". *Night waking* was dichotomized to 3+ vs. 0-2 wakings. LSRSPs were assessed with questions "what is the longest stretch of time that your baby is asleep during the night without waking up?" and "what is the longest stretch of time that your baby is asleep during the day without waking up?" Response options were "(Less than 30 min, 30 min-1 hr, 1-2 hr, 2-3 hr, 3-4 hr, more than 4 hr)". *Night LSRSP* was dichotomized to ≤ 4 hr vs. > 4 hr, *Day LSRSP* was dichotomized to ≤ 1 hr vs. > 1 hr. *Perceived sleep problem* was assessed with a single item from the Brief Infant Sleep Questionnaire (BISQ; Sadeh, 2004): "In general, do you consider your child's sleep a problem?" Response options were "a very serious problem, a small problem, not a problem at all"; affirmative responses were combined to create the binary variable.

Preschooler sleep variables at T3 pertained to sleep duration and timing, as well as clinically significant and maternally perceived sleep problems. Most variables were obtained from the Children's Sleep Habits Questionnaire (CSHQ); a widely used parent-report measure designed to screen for paediatric sleep problems (Owens et al., 2000). Originally designed for use with school-aged children, the CSHQ has been validated for use with toddlers and preschoolers (Goodlin-Jones et al., 2008). It is comprised of 45 items examining paediatric sleep behaviors occurring in a 'typical' recent week. Most items are rated on a three-point scale: usually (5-7 times/week); sometimes (2-4 times/week); and rarely (0-1 time/week). Open-response items assess sleep timing and duration. Thirty-three CSHQ items were summed to produce a total CSHQ score, with scores able to range from 33 to 99. A higher score is indicative of more disturbed sleep, and a total CSHQ score of over 41 is thought to indicate a clinically significant paediatric sleep problem (Markovich et al., 2015; Owens et al., 2000).

Week and weekend *sleep durations* were assessed with CSHQ items pertaining to usual sleep durations per 24 hours, including naps. Consistent with NSF sleep duration guidelines (Hirshkowitz et al., 2015) and prior research (Muller et al., 2019c), *sleep duration* variables were categorized as short (< 10 hr)/ recommended (10-13 hr)/ long (> 13 hr). *Midsleep difference* and

social jetlag, were calculated from CSHQ items on wake times during the week (Monday to Friday) and on weekends (Saturday and Sunday), and additional items assessing sleep start times (as opposed to bedtimes) on week (Sunday to Thursday) and weekend evenings (Friday and Saturday). *Midsleep difference* was calculated as the absolute difference, in hours, between weeknight and weekend midsleep times (i.e., the midpoint between a child's usual sleep start and wake times). Midsleep difference was dichotomized to produce a *social jetlag* (≥ 1hr vs. < 1hr) variable (see Muller et al. (Muller, Paine, et al., 2020)). *CSHQ-indicated sleep problem* was defined as CSHQ score > 41 (Markovich et al., 2015; Owens et al., 2000). *Perceived sleep problem* was assessed with an additional item asking how much of a problem respondents found their child's sleeping patterns or habits; "no problem, small problem, moderate problem, large problem". Responses were dichotomized to moderate/large vs. no/small problem.

6.1.1.2 Statistical analyses

All analyses were conducted using IBM SPSS statistical software (Version 28.0). Descriptive statistics are presented by maternal ethnicity (Māori/non-Māori, as measured at T1). Bivariate associations between maternal mood (clinically significant depressive symptoms: Yes/No) and sleep characteristics at each time point are then reported. Independent t tests were used for continuous demographic variables, and Pearson chi-square tests for categorical demographic variables. Finally, binary logistic regression models were fitted to produce adjusted odds ratios and 95% confidence intervals for all binary sleep outcome variables. Independent variables in *infant models* were pre- and postnatal EPDS scores (continuous variables), maternal ethnicity at T1, maternal age at T1, NZDep level at T1, child age at T2, and child sex. *Preschooler models* included the same independent variables, plus K-10 scores (continuous variable) and infant (T2) sleep variables (night waking, night LSRSP, day LSRSP and perceived sleep problem). Child age in preschooler models was measured at T3. To ensure adequate events per variable (EPV), some demographic variables (including parity, gestational age at birth, birth weight) were not included.

Short sleep models compared short (< 10 hr) to recommended (10-13 hr), excluding long (> 13 hr) sleep durations per 24 hours. Long sleep was excluded from all analyses due to low rates/insufficient power (total *n* = 44 week, *n* = 39 weekend). Social jetlag (*n* = 51 ≥ 1 hr) was not modelled due to insufficient EPV. We conducted linear regression diagnostics to obtain tolerance statistics for the independent variables used in infant and preschooler models. All tolerance statistics were above the threshold of .20, indicating no significant multicollinearity (Field, 2018; Menard, 2002).

Results

Participants were 856 women (*n* = 262 Māori and *n* = 594 non-Māori) who completed questionnaires at each of the three data collection points. Prior *Moe Kura* research showed that this dataset represents 75% of the baseline cohort (Ladyman et al., 2021). A comparison of T1 characteristics between those with complete and incomplete datasets (Ladyman et al., 2021) showed that participants who could not be included in analyses were more likely to be younger ($p < .001$), identify as Māori ($p < .001$), live in a more deprived area ($p < .001$), and have a higher prenatal EPDS score ($p = .030$). There were no attrition-related differences in parity, or prevalence of clinically significant depressive symptoms (EPDS score ≥13) in pregnancy.

6.1.1.3 Sample characteristics

The demographic characteristics of the Māori and non-Māori samples at each data collection point are presented in Table 6.1. Māori mothers were younger on average and more likely to be living in high deprivation areas. Māori mothers reported more depressive symptoms during pregnancy (T1) and at 3 years post-birth (T3), but not at 12 weeks postnatal (T2). Non-Māori mothers were more likely to be nulliparous at T1 ($p = .019$). There was no difference in the likelihood of having child(ren) younger than the *Moe Kura* child at T3 by ethnicity. The children of Māori and non-Māori mothers did not differ in sex, age, or gestational age at delivery

Table 6.1: *Sample characteristics of mothers and children by maternal ethnicity*

	T1 (Pregnancy) Mean ± SD or % (95% CI)				T2 (~12w postpartum) Mean +/- SD or n (%)				T3 (Child age ~3y) Mean +/- SD or n (%)			
	Māori n = 262	non-Māori n = 594	Total n = 856	p value	Māori* n = 262	non-Māori* n = 594	Total n = 856	p value	Māori* n = 262	non-Māori* n = 594	Total n = 856	p value
Maternal characteristics												
Age (y)	28.45 ± 6.25	31.91 ± 5.06	30.85 ± 5.68	**<.001**	28.75 (6.16)	32.22 (5.07)	31.16 (5.66)	**<.001**	31.60 ± 6.29	35.15 ± 5.07	34.07 ± 5.71	**<.001**
NZDep, n (%) [a]				**<.001**				**<.001**				**<.001**
Low deprivation (deciles 1-3)	44 (16.8)	241 (40.6)	285 (33.3)		43 (16.4)	240 (40.5)	283 (33.1)		44 (17.4)	279 (49.0)	323 (39.3)	
Moderate (deciles 4-7)	104 (39.7)	253 (42.7)	357 (41.7)		105 (40.1)	252 (42.5)	357 (41.8)		93 (36.8)	207 (36.4)	300 (35.0)	
High deprivation (deciles 8-10)	114 (43.5)	99 (16.7)	213 (24.9)		114 (43.5)	101 (17.0)	215 (25.1)		116 (45.8)	83 (14.6)	199 (23.2)	
Parity [b], n (%)												
Nulliparous at T1	113 (44.8)	316 (53.7)	429 (50.1)	**0.019**								
Younger child(ren) at T3									90 (34.6)	323 (39.2)	322 (37.6)	0.205
Psychological Distress [c]												
EPDS/K-10 mean	8.80 ± 5.02	7.61 ± 4.71	7.97 ± 4.83	**<.001**	6.09 ± 4.78	5.46 ± 4.01	5.65 ± 4.27	0.064	7.57 ± 6.16	6.12 ± 4.97	6.56 ± 5.40	**<.001**
EPDS/K-10 clinically significant [d], n (%)	57 (22.0)	86 (14.5)	143 (16.8)	**0.007**	31 (11.9)	40 (6.8)	71 (8.3)	**0.013**	57 (21.8)	77 (13.0)	134 (15.7)	**<.001**
Child characteristics												
Sex (f) [e], n (%)									127 (48.8)	302 (51.5)	429 (50.7)	0.407
Ethnicity, n (%)								**<.001**				**<.001**
Māori					248 (94.7)	52 (8.8)	300 (35.0)		253 (96.9)	58 (9.8)	311 (36.4)	
non-Māori					14 (5.3)	542 (91.2)	556 (65.0)		8 (3.1)	535 (90.2)	543 (63.6)	
Gestational or Child Age [f]	35.91 ± 0.97	35.82 ± 0.85	35.85 ± 0.89	0.177	12.05 ± 1.28)	12.05 ± 1.18	12.05 ± 1.21	0.963	3.13 ± 0.31	3.15 ± 0.27	3.15 ± 0.28	0.326
Gestational age at delivery (w) [g]					39.79 ± 1.42	39.69 ± 1.52	39.71 ± 1.49	0.372				

Data presented as mean (SD) except where indicated as n (%).
* Maternal ethnicity as reported during pregnancy
a 1, 1, and 34 missing cases for NZDep categories at T1, T2 and T3, respectively
b 15 and 4 missing cases for parity status at T1 and T3, respectively
c 3 and 3 missing cases for psychological distress scores at T1 and T2, respectively
d Defined as EPDS ≥13, K-10 ≥ 12
e Child sex was first measured at T3, 10 missing
f Gestational age at T1 and child age at T2 measured in weeks, child age at T3 measured in years
g 5 missing cases for gestational age at delivery

6.1.1.4 Bivariate associations

The sleep characteristics of infants and preschoolers by maternal mental health status (i.e., with or without clinically significant depressive symptoms as indicated by the EPDS/K-10) are presented in Table 6.2. ***Prenatal depression:*** Children born to mothers who had clinically significant depressive symptoms in pregnancy (T1) were more likely to have shorter (≤ 4hr) night LSRSP at 12 weeks (T2). At 3 years (T3), their average weekday and weekend sleep durations were shorter, and they were more likely to have short weekend sleep duration. They also had higher average midsleep differences, higher average CSHQ scores, and were more likely to have a CSHQ-indicated sleep problem. ***Postnatal depression:*** Mothers with clinically significant postnatal depressive symptoms (T2) were more likely to perceive a concurrent infant sleep problem. At 3 years (T3), children whose mothers had experienced clinically significant postnatal depressive symptoms at T2 had shorter average sleep durations and were more likely to have short weekend sleep. They also had higher average CSHQ scores and were more likely to have a CSHQ-indicated sleep problem. ***Depression at 3 years post-birth:*** Children of mothers with clinically significant depressive symptoms at T3 were more likely to have short weekend sleep, higher average CSHQ scores, and exhibit perceived and CSHQ-indicated sleep problems.

Table 6.2: *Infant and preschooler sleep measures by prenatal, postnatal and 3-year post-birth maternal depressive symptoms above or below clinical cut-offs*

	Prenatal				Postnatal				Child 3y			
	EPDS ≥ 13		EPDS < 13		EPDS ≥ 13		EPDS < 13		K-10 ≥ 12		K-10 < 12	
12 weeks, *% (95% CI)*	n		n		n		n		n		n	
Night wakings (3+)	16	11.2 (6.8-17.1)	62	8.7 (6.8-11.0)	11	15.5 (8.5-25.2)	67	8.6 (6.8-10.7)				
Night LSRSP (≤ 4hr)	30	21 (14.9-28.2)	80	11.3 (9.1-13.8)**	14	19.7 (11.8-30.1)	97	12.4 (10.2-14.9)				
Day LSRSP (≤1h)	15	10.5 (6.3-16.3)	67	9.4 (7.5-11.8)	9	12.7 (6.5-21.9)	73	9.3 (7.4-11.5)				
Perceived Sleep Problem	35	24.5 (18.0-32.0)	172	24.2 (21.2-27.5)	30	42.3 (31.3-53.9)	177	22.6 (19.8-25.7)***				
3 Years, *% (95% CI) OR mean ± SD*												
Sleep Duration												
24 hr Sleep Duration, hours[a]												
Weekday	137	11.06 ± 1.42	693	11.41 ± 1.26**	66	10.97 ± 1.37	764	11.38 ± 1.28*	128	11.16 ± 1.41	705	11.38 ± 1.27
Weekend	134	10.82 ± 1.57	693	11.39 ± 1.23***	63	10.76 ± 1.53	764	11.33 ± 1.27**	125	11.15 ± 1.66	705	11.32 ± 1.23
Short Sleep Duration Wk (< 10/24 hr), % (95% CI)	16	11.7 (7.1-17.8)	50	7.2 (5.5-9.3)	8	12.1 (5.9-21.6)	58	7.6 (5.9-9.6)	14	10.9 (6.4-17.2)	52	7.4 (5.6-9.5)
Short Sleep Duration Wknd (< 10/24 hr), % (95% CI)	25	18.7 (12.8-25.9)	48	6.9 (5.2-9.0)***	14	22.2 (13.3-33.6)	59	7.7 (6-9.8)***	17	13.6 (8.4-20.4)	56	7.9 (6.1-10.1)*
Social Jetlag												
Midsleep difference, min	128	19.91 ± 23.13	674	15.25 ± 20.58*	61	15.94 ± 18.38	741	16.00 ± 21.31	119	15.85 ± 20.06	686	16.01 ± 21.25
Social Jetlag ≥ 1 hr	12	9.4 (5.2-15.3)	39	5.8 (4.2-7.7)	3	4.9 (1.4-12.5)	48	6.5 (4.8-8.4)	5	4.2 (1.6-9.0)	46	6.7 (5.0-8.8)
CSHQ												
CSHQ total	143	44.73 ± 8.89	708	41.67 ± 8.37***	71	45.45 ± 9.45	780	41.91 ± 8.38***	133	45.71 ± 9.41	721	41.54 ± 8.19***
CSHQ-indicated sleep problem[b]	96	67.1 (59.2-74.4)	348	49.2 (45.5-52.8)***	52	73.2 (62.2-82.5)	393	50.4 (46.9-53.9)***	94	70.7 (62.6-77.9)	352	48.8 (45.2-52.5)***
Perceived Sleep Problem												
Moderate – large	29	20.3 (14.3-27.4)	114	16.1 (13.6-19.0)	14	19.7 (11.8-30.1)	130	16.7 (14.2-19.5)	35	26.3 (19.4-34.3)	110	15.3 (12.8-18.1)**

*p < .05, **p < .01, ***p < .001

[a] outlier of 4 hr sleep duration removed

[b] Defined as total CSHQ Score > 41

6.1.1.5 Binary logistic regression associations between maternal depressive symptomology and child sleep

Tables 6.3 and 6.4 present the results of binary logistic regression models investigating longitudinal associations between maternal depressive symptoms and infant and preschooler sleep, respectively. All models controlled for key demographic factors; preschooler models also controlled for prior sleep variables. ***Infant sleep:*** There were no independent associations between prenatal depressive symptoms and infant sleep variables at 12 weeks. However, concurrent postnatal depressive symptoms were independently associated with more night waking (≥ 3 vs. < 3 wakings/night), shorter night LSRSP (≤4 hr vs. >4 hr), and perceived problem sleep. ***Preschooler sleep:*** Preschoolers whose mothers had experienced more depressive symptoms during pregnancy were more likely to exhibit short sleep, both during the week (OR 1.084 (1.020-1.152)) and on weekends (OR 1.079 (1.017-1.144)). There were no associations between postnatal depressive symptoms and preschooler sleep variables. However, concurrent maternal depressive symptoms at 3-years post birth were independently associated with both CSHQ-identified and parent-perceived sleep problems.

Table 6.3: *Adjusted[a] associations between maternal depressive symptoms^ and binary infant sleep outcomes*

	Odds Ratio (95% CI)			
	Night wakings ≥ 3	Night LSRSP ≤ 4hr	Day LSRSP ≤ 1hr	Perceived Prob
Prenatal EPDS	1.00 (0.95-1.06)	1.05 (1.00-1.10)	1.02 (0.96-1.07)	0.98 (0.94-1.02)
12w Postnatal EPDS	1.07 (1.01-1.13)*	1.05 (1.00-1.11)*	1.04 (0.98-1.10)	1.13 (1.09-1.18)***

Note: Odds ratios indicate the change in odds of a given sleep outcome for each one-point increase in EPDS/K-10 score. The SDs for the EPDS were 4.83 (prenatal) and 4.27 (postnatal).
^ All depression measures entered as continuous independent variables
[a] In addition to depression at both time points, independent variables included in the infant sleep models were maternal ethnicity at T1, maternal age at T1, NZDep level at T1, child age at T2, and child sex
*p < .05, **p < .01, ***p < .001

Table 6.4: *Adjusted[a] associations between maternal depressive symptoms^ and binary preschooler sleep outcomes*

	Odds Ratio (95% CI)			
	Short wk (< 10 hr)	Short wknd (< 10 hr)	CSHQ-indicated Prob[b]	Perceived Prob
Prenatal EPDS	1.08 (1.02-1.15)*	1.08 (1.02-1.14)*	1.03 (0.99-1.07)	1.03 (0.98-1.08)
12w Postnatal EPDS	0.96 (0.89-1.03)	1.02 (0.95-1.09)	1.04 (1.00-1.08)	0.97 (0.92-1.02)
3y Post-birth K-10	1.01 (0.96-1.07)	1.02 (0.97-1.07)	1.07 (1.03-1.10)***	1.07 (1.03-1.11)**

Note: Odds ratios indicate the change in odds of a given sleep outcome for each one-point increase in EPDS/K-10 score. The SDs for the EPDS were 4.83 (prenatal) and 4.27 (postnatal). The SD for the K-10 was 5.40.
^ All depression measures entered as continuous independent variables
[a] In addition to depression at all time points, independent variables included in the preschooler sleep models were maternal ethnicity at T1, maternal age at T1, NZDep level at T1, , child age at T3, and T2 sleep variables (night waking, night LSRSP, day LSRSP and perceived sleep problem)
[b] Defined as total CSHQ Score > 41
*p < .05, **p < .01, ***p < .001

Discussion

This study contributes to our nascent understanding of the relationships between maternal depression and sleep in young children. Bivariate analyses showed clinically significant prenatal depressive symptoms were associated with short night LSRSP in infants aged 12 weeks, and with shorter sleep duration, greater average midsleep difference, higher average CSHQ score, and higher rates of CSHQ-identified sleep problems in preschoolers aged 3-4 years. Clinically

significant postnatal depressive symptomology was associated with several parallel infant sleep variables, as well as subsequent preschooler sleep outcomes.

After controlling for key maternal demographic variables, infant sleep characteristics, and postnatal and concurrent maternal depressive symptoms, prenatal depressive symptoms continued to be independently associated with short week- and weekend sleep duration in preschoolers. Adjusted models showed no prospective associations between prenatal depression and infant sleep. Consistent with established literature (Bayer et al., 2007; Martin et al., 2007; Teti & Crosby, 2012; Ystrom et al., 2017), we found concurrent relationships between maternal depression and infant night sleep characteristics, and clinically significant preschooler sleep problems, indicated by the CSHQ. Perhaps reflecting these associations, we also found that mothers with greater depressive symptomology were more likely to experience their child's sleep as problematic at both time points.

The marginal effect sizes indicated by the odds ratios in the logistic regression models belie meaningful increases in odds of short preschooler sleep duration conferred by maternal depression. For example, the odds ratios for short sleep indicate that for every one-point increase on the prenatal EPDS, the odds of a child exhibiting shorter-than-recommended sleep at 3 years increase by 8.4% and 7.9%, for week and weekend sleep, respectively. An increase of one standard deviation on the prenatal EPDS (4.83 points) therefore equates to a 40.6% (week) and 38.2% (weekend) greater odds of short sleep. This is particularly striking when we note that this relationship exists over and above how the children slept as infants, as well as mothers' postnatal and concurrent depressive symptoms, and key demographic variables including ethnicity and SEP.

While this study contributes to an emerging pattern within the literature that shows prenatal depression is associated with subsequent child sleep, broadly defined, it also adds to the inconsistencies. In line with some findings (Galbally et al., 2018) and contrasting with others (de

Freitas et al., 2020; Morales-Munoz et al., 2018), our adjusted models showed no associations between prenatal depression and infant sleep. Together, findings to date suggest clear relationships are difficult to detect at such an early stage of infant development, when sleep is highly variable (Galland et al., 2012). Our findings also contribute to inconsistency regarding which specific aspects of preschooler sleep are affected by prenatal depression (Morales-Munoz et al., 2018; O'Connor et al., 2007; Tikotzky et al., 2021). For example, after controlling for covariates O'Connor et al. (O'Connor et al., 2007) found an association between prenatal maternal mood and preschooler sleep problems but not sleep duration, whereas we found the reverse: In our adjusted models, prenatal mood was associated with week and weekend short sleep durations, but not sleep problems. Like us, Toffol et al. (2019) found an association between prenatal mood and sleep duration, but they also found an association with sleep problems where we did not. Methodological factors may account for the variability in these associations, such as sample demographics and measures used. For example, Toffol et al. (2019) used The Sleep Disturbance Scale for Children (SDSC) with their sample of Finnish participants. The SDSC differs from the CSHQ in terms of sleep problems indexed and populations with whom the measures were validated (Bruni et al., 1996; Owens et al., 2000). As more evidence accumulates on this important topic, meta-analyses should confirm the specific dimensions of paediatric sleep health most impacted. Inconsistences could also stem from the time at which depressive symptoms were measured during pregnancy. Though several studies suggest prenatal depression is highly stable across pregnancy (Egliston et al., 2006; Heron et al., 2004), others show heterogeneity in symptom trajectories (Waqas et al., 2023). Future research could explore potential sensitive periods in gestation that are especially vulnerable to effects of prenatal depression on child sleep, based on the developmental timing of relevant brain regions (Van den Bergh et al., 2020). The question of sensitive periods was considered by Toffol et al. (2019), but the stability of depressive symptoms in their sample precluded thorough examination of pregnancy stage-specific associations.

Our findings underscore the public health message sent by Toffol et al. (2019) that treatment interventions designed to support maternal mental health during pregnancy have the potential to alleviate at least some of the sleep problems that affect a large paediatric population. Compared to postnatal depression, prenatal depression is an underrecognized risk factor for suboptimal family health outcomes (Martin et al., 2021). Prior research indicates help-seeking rates among women experiencing depression during pregnancy are low (Signal et al., 2017). This highlights the need for effective population-level policies and intervention programs, including robust systems to identify those who are suffering. Depression screens should be used routinely in preconception and prenatal care. Those at risk should be supported with mental health services that are fit for purpose across and beyond the perinatal period (Clapham et al., 2024). The current findings suggest early intervention could help prevent shorter-than-recommended sleep in early childhood and therefore support long-term cognitive, emotional, behavioural, and academic functioning in children (Meltzer et al., 2021). Furthermore, effective intervention before and during pregnancy could prevent the continuation or development of maternal depression at later stages (Clatworthy, 2012; Yasuma et al., 2020), and the concurrent child sleep problems associated. Given the complex interplay posited in the transactional model of sleep development (Sadeh & Anders, 1993), improvements in child sleep are likely to also promote maternal sleep and mental health and thus contribute to an 'upward spiral' in overall family well-being.

To our knowledge, this is the first study to explore the relationships between prenatal depression and infant and preschooler sleep in a large, ethnically and socio-economically diverse sample. It is imperative that research includes Indigenous and other non-White groups. These populations are subject to institutional racism which produces and maintains systemic inequities in the social determinants of health broadly, and sleep health specifically (Ordway et al., 2020; Paine & Muller, 2023; Reid & Robson, 2007). Participation in research is critical to addressing these inequities and to upholding rights to health that are clearly outlined in the United Nations Declaration of the Rights of Indigenous Peoples (UNDRIP), as well as in te Tiriti o Waitangi/the Treaty of Waitangi

in NZ (HQSC, 2019; Paine & Gander, 2013; Reid & Robson, 2007; United Nations, 2007). Other strengths of the current study include the range of paediatric sleep variables explored, and the incorporation of numerous covariates, including infant sleep characteristics and maternal depressive symptoms measured at earlier and parallel time points.

Our findings should be considered in light of the study's limitations. First, we used mother-rated measures of child sleep- an established methodology for large-scale studies. We assessed commonly explored variables and included the well-validated CSHQ, but our results cannot be generalized to objectively measured sleep characteristics. While we were able to control for numerous important covariates, we were insufficiently powered to account for all variables known to be relevant to maternal depression and child sleep. For example, research within *Moe Kura* has demonstrated the relevance of factors such as stressful life events and social support (Ladyman et al., 2021; Paine et al., 2022; Signal et al., 2017), neither of which could be considered here. However, prior cross-sectional analyses suggest maternal depression-child sleep relationships are robust to these and other covariates (Carter et al., in press). Despite the strength of our sample's ethnic and socio-economic diversity, sample characteristics differed somewhat from those of *Moe Kura's* baseline cohort (Signal et al., 2017). Importantly though, attrition similarly affected our Māori and non-Māori groups, such that neither group differed from their baseline counterparts in terms of prenatal depression prevalence, a key construct of interest. Issues with shared-method variance are possible given that mothers reported on both depressive symptoms and child sleep. Cognitive biases typical of depression might cause mothers to experience (and rate) their children's sleep as more problematic (Goldberg et al., 2013; Teti & Crosby, 2012). Additionally, maternal sleep disturbances – a characteristic of depression – might make mothers more sensitive to their children's sleep disturbances (e.g., brief wakings), leading to overreporting of child sleep problems (Rönnlund et al., 2016). These phenomena could account for the strong relationship between maternal depressive symptoms and sleep problems measured in parallel at both 12 weeks and 3 years post-birth. However, they are unlikely to

account for our longitudinal findings, as prenatal depressive symptoms showed effects on preschooler sleep duration that were independent of concurrent maternal depressive symptoms.

6.1.1.6 Conclusion

Our findings suggest short sleep is one pathway by which maternal depression confers risk for suboptimal child health outcomes. Clinically significant depressive symptomology in the third trimester of pregnancy was associated with shorter average weekday and weekend sleep duration among children at preschool age. Prenatal depressive symptoms were associated with shorter-than-recommended sleep at age 3 years, over and above the impact of key maternal demographic variables, prior infant sleep characteristics, and postnatal and parallel maternal depressive symptoms. Clinically significant postnatal depressive symptoms were also associated with several concurrent and future child sleep characteristics in bivariate models, but only the concurrent relationships between postnatal depression and child sleep remained after adjusting for covariates. Based on these findings, we echo calls for earlier and better mental health support for mothers. Support should be fit for purpose across and beyond the perinatal period. Appropriately addressing maternal depression is likely to benefit child sleep and the myriad domains of child- and family wellbeing that are supported by paediatric sleep health.

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Data availability statement. The data used in this research can be shared on reasonable request to the corresponding author and with agreement from the original *Moe Kura* research team.

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CHAPTER 7 GENERAL DISCUSSION

An overarching aim of this thesis was to explore relationships between maternal PND and child sleep in infants and preschoolers, with a focus on health equity in the NZ context. This chapter provides a summary of findings in relation to the research aims, followed by a discussion of key research contributions made by this work. Clinical implications, strengths, limitations and avenues for future research are then outlined. A summary of the key findings and their significance concludes this chapter and this thesis.

7.1 Summary of Key Findings

Characterisation and comparison of the sleep of 12-week-old infants of Māori and non-Māori NZ women

High between-infant variability was seen in sleep characteristics. Within-infant variability was also indicated. The infants of Māori and non-Māori mothers differed somewhat in *where* but less in *how* they were sleeping. That is, key developmental markers of sleep development (night waking, LSRSP) did not differ by maternal ethnicity, but sleep location did. Both bedsharing and room-sharing were more commonly reported by Māori mothers, whereas independent infant sleep was more commonly reported by non-Māori mothers. A variety of factors were associated with perceived problems, and these did not always align with commonly accepted markers of sleep development. For example, night waking was associated with a perceived problem, but night LSRSP was not. Day sleep – a relatively under researched domain – was particularly variable and relevant to perceived problems.

Socio-ecological factors associated with infant sleep characteristics

As noted above, maternal ethnicity was not independently associated with key measures of infant sleep development, including night waking, nighttime LSRSP, night sleep location change, or the

infant having help from others to go to sleep. Higher deprivation was associated with higher odds of bedsharing and room-sharing, and lower odds of independent sleep, but was not associated with developmental markers of sleep. Factors associated with increased odds of night waking were older maternal age, more maternal depression symptoms, exclusive breastfeeding, having returned to work, and bedsharing. Factors associated with shorter night LSRSP were maternal depression symptoms, and bedsharing.

Features of infant sleep that contribute to a mother-perceived infant sleep problem

Factors associated with **increased odds** of perceived problematic sleep included night waking, short day LSRSP, more maternal depression symptoms, frequent day-to-day change, infant having help settling to sleep, and fewer maternal opportunities for sleep and rest. Conversely, factors associated with **decreased odds** of a perceived sleep problem were multiparity, greater relationship satisfaction, higher life stress, being in paid employment, and bedsharing.

Sleep characteristics during infancy and early childhood of children born to mothers with and without clinically significant depressive symptomology

Prenatal depression: Children born to mothers who had clinically significant depressive symptoms in pregnancy (T1) were more likely to have shorter (≤ 4hr) night LSRSP at 12 weeks (T2). At 3 years (T3), their average weekday and weekend sleep durations were shorter, and they were more likely to have short weekend sleep duration. They also had higher average midsleep differences, higher average CSHQ scores, and were more likely to have a CSHQ-indicated sleep problem. ***Postnatal depression:*** Mothers with clinically significant postnatal depressive symptoms (T2) were more likely to perceive a concurrent infant sleep problem. At 3 years (T3), children whose mothers had experienced clinically significant postnatal depressive symptoms at T2 had shorter average sleep durations and were more likely to have short weekend sleep. They

also had higher average CSHQ scores and were more likely to have a CSHQ-indicated sleep problem. ***Depression at 3 years post-birth:*** Children of mothers with clinically significant depressive symptoms at T3 were more likely to have short weekend sleep, higher average CSHQ scores, and exhibit perceived and CSHQ-indicated sleep problems.

Maternal perinatal depressive symptomology as a predictor of sleep patterns and problems during infancy and early childhood, controlling for maternal depressive symptoms at subsequent time points

Infant sleep: After controlling for key covariates, maternal prenatal depressive symptomology was not associated with infant sleep variables at 12 weeks. However, concurrent postnatal symptomology was associated with more night waking, shorter night LSRSP, and perceived problem sleep. ***Preschooler sleep:*** Preschoolers whose mothers had experienced more depressive symptoms during pregnancy were more likely to exhibit short sleep, both during the week and on weekends. There were no associations between postnatal depressive symptoms and preschooler sleep variables. However, concurrent maternal depressive symptoms at 3-years post birth were independently associated with both CSHQ-identified and parent-perceived sleep problems.

7.2 Research Contribution

The current thesis makes three primary contributions to the literature on maternal depression and child sleep. First, it provides normative data on infant sleep, which can help parents and healthcare providers establish realistic expectations about sleep development and help alleviate secondary distress associated with infant sleep challenges. Second, it supports a broader timeframe for focusing on maternal mental health, demonstrating the importance of screening and treating maternal depression not only in the postpartum period but also during pregnancy

and throughout early childhood. Third, the thesis supports social determinants explanations of health inequities, underscoring the need for public policies that address institutional racism and other structural barriers to achieving equitable sleep health for Māori.

Contribution 1: The provision of normative data

Study One provides some of the first normative data on the sleep characteristics of 12-week-old NZ infants using a sample with good Indigenous representation and socioeconomic distribution that broadly reflects the NZ community. This includes normative data on day sleep characteristics, which are underexplored in literature relative to their prominence in perceptions of sleep problems established in our findings and elsewhere (Mindell et al., 2022). Study One provides robust and detailed evidence that sleep patterns vary widely between infants, and within-infant variability is also common. This data helps to normalise many aspects of infant sleep that are currently perceived as sleep problems, such as night waking and infants requiring support to settle to sleep (Mindell et al., 2022). More than one quarter of the infants in Study One regularly woke twice a night, and around half often or always received help settling to sleep, yet both characteristics were associated with more than twice the odds of a perceived problem. It is important to note that although this data is "normative" in that it shows the distribution of sleep characteristics within representative samples, it is not yet known whether any part of this distribution is "problematic" for the infants' future health and well-being.

If communicated effectively, the data from Study One could help to alleviate at least some of the distress experienced by parents of young children. The rationale for this draws heavily on theories of social and clinical psychology. As social beings, humans regularly engage in impression management; "the goal-directed activity of controlling information to influence the impressions formed by an audience" (Schlenker, 2003, p. 492). Impression management of self-relevant information is referred as 'self-presentation' (Schlenker, 2003). Often, people engage in idealised or curated self-presentation, preferencing positive aspects of their experience and concealing

struggles. This is done for variety of reasons, including self-esteem regulation, the desire for social approval, or fear of judgement (Schlenker, 2003). Social comparison theory, originally proposed by Leon Festinger in 1954, helps to explain how individuals evaluate their own abilities, achievements, and challenges by comparing themselves to others (Festinger, 1957). Upward social comparison can occur when individuals compare their own challenges to the others' idealised self-presentation (Schlenker, 2003). This can result in feelings of abnormality, inadequacy, or failure, as others seem to have fewer struggles. The belief that one's struggles are abnormal or worse than those of others can generate psychological distress, such as depression or anxiety. In response, individuals may be motivated to present their own idealised versions of life, however the resulting self-discrepancy can inadvertently perpetuate the distress the behaviour seeks to mitigate (Higgins, 1987). Ultimately, idealised self-presentation from a desire to "fit in" with the perceived norms perpetuates their distortion, thereby reinforcing the distress cycle. Indeed, normalisation is a central tenet of Cognitive Behavioural Therapy (CBT) – a gold-standard psychological treatment for depression – and many other forms of mental distress and disorder (NICE, 2022). CBT draws, in part, on cognitive models (Beck, 2002) that centre the individual's appraisal of an external or internal event as the driver of emotional, behavioural, and physiological response (Padesky & Mooney, 1990). According to these theories, a mother who appraises her infant's night waking as a problem is more likely to feel distressed than if she appraised it as normal, and a 'problem' appraisal is more likely in the absence of normative data.

High quality, normative data are needed now more than ever. Social media has increased exposure to idealised self-presentations to levels that are likely unimaginable to early social comparison theorists. We now have near-constant opportunities for upward social comparison that reach well beyond our immediate social circles to influencers, celebrities, strangers, and all manner of purported 'experts' across the globe. Research shows parents frequently turn to social media for advice on parenting and infant health, and information shared on infant sleep is especially misinformed and often dangerous (Kallem et al., 2018; Moon et al., 2019). The

dissemination of scientifically grounded, normative data on infant sleep characteristics provides parents with an alternative basis for comparison that facilitates informed, evidence-based decisions about their own situation. Rather than feeling that they need to "fix" something based on idealised presentations, parents can assess whether their infant's sleep is within a typical range, or if it truly needs intervention. While normative data is not a panacea, and the significant challenges of parental sleep deprivation posed by normal infant sleep patterns should not be minimised, normative data can help alleviate the added layer of distress that comes from perceiving these challenges as abnormal or problematic. By providing parents with a clearer understanding of what is typical, the data presented in Study One can reduce the 'meta-distress' – the anxiety, frustration, and depression – that can arise when parents believe their experiences are uniquely difficult or outside the norm.

Contribution 2: Evidence-based grounds to broaden the spotlight on maternal mental health

Findings presented in this thesis build on established literature emphasising the importance of addressing maternal postnatal depression for the benefit of women, as well as their children and wider whānau. They also reveal a critical need to go further; to support women in pregnancy (ideally from pre-conception), and well beyond their children's first birthdays. Both studies presented in this thesis identified cross-sectional relationships between postnatal maternal depression and child sleep. Study Two showed that depression in pregnancy was associated with short sleep duration (i.e., < 10–13 hr per 24 hr ; Hirshkowitz et al., 2015; Ministry of Health, 2018) in children at preschool age, after controlling for key covariates, including postpartum and concurrent depressive symptoms. Study Two also showed relationships between concurrent maternal depression and sleep problems in preschoolers that remained after controlling for pre- and postnatal depressive symptoms. These two more novel findings are explored here in greater detail than was afforded in the original manuscripts.

7.2.1.1 The importance of depression in pregnancy

Historically, maternal depression research has focused on the postnatal period. Yet, prenatal maternal depression is one of the most common pregnancy complications, and research indicates depression is more prevalent and more severe in pregnancy, than in the postnatal period (Davis et al., 2018). In a large cohort study, (Evans et al., 2001) found prenatal EPDS scores were higher, on average, than postnatal scores, and more women scored above the clinical cut-off of ≥ 13 during pregnancy, than in the weeks and months following birth.

The findings on prenatal depression and preschooler sleep duration contribute to a burgeoning body of literature emphasising the critical role of the foetal environment in shaping a child's long-term health and development (Barker, 1998; Davis et al., 2011; Galbally et al., 2018; Jagtap et al., 2023; O'Connor et al., 2014). Sleep duration is recognised as so essential to child health that it is the subject of its own consensus statement by the AASM (Paruthi et al., 2016). It is well established that children who regularly sleep fewer than the number of recommended hours for their age are at risk of numerous adverse academic and health outcomes, including problems with attention, learning, and behaviour, as well as increased risk for accidents, injuries, hypertension, diabetes, and depression (Paruthi et al., 2016). Importantly, disparities in sleep duration may not always be readily reversible. While analysis of GUiNZ data suggests sleep duration may improve somewhat as children get older (Muller, Santos-Fernandez, et al., 2022), other research indicates sleep duration shows trait-like stability across development (Jenni et al., 2007), and the consequences of short sleep appear to increase in severity with age. Adolescents who regularly attain shorter-than-recommended sleep are at greater risk of self-injurious thoughts and behaviours, including suicide attempts (Paruthi et al., 2016). Many of these outcomes match those described in studies on the impact of PND on offspring health and development across the lifespan, suggesting short sleep duration may be one pathway contributing to the

intergenerational transmission of adverse health outcomes (Betts et al., 2014; Galbally et al., 2022; Korhonen et al., 2012; Leigh & Milgrom, 2008; O'Donnell et al., 2014; Signal et al., 2017).

An unexpected finding from Study Two was that prenatal depression was not associated with infant sleep outcomes, after controlling for key covariates. One explanation for this is that the effects are not observable at such a young age, when development is particularly rapid and sleep especially variable (Galland et al., 2012; Paruthi et al., 2016). In a prospective study of the effects of maternal prenatal psychosocial stress on infant stress regulation, Davis et al. (2011) found that prenatal stress was not significantly correlated with cortisol regulation in newborns, but that these associations appear to emerge later in development (Davis et al., 2011; Van den Bergh et al., 2020). These findings contribute to our evolving understanding of complexity inherent in etiological processes.

It is interesting to contemplate possible evolutionary explanations for why exposure to prenatal depression in utero might predispose offspring to short sleep in early childhood via foetal programming (Barker, 1998; Glover et al., 2010). As discussed in Chapter 2, dysregulated HPA axis function is a characteristic feature of MDD (and PND) (Glynn et al., 2013). Exposure to altered maternal stress signals might programme the infant brain in a way that was advantageous to our human and animal ancestors (Glover et al., 2018). Indeed, many of the changes that are considered mental disorder today, such as anxiety, depression, and attention-deficit/hyperactivity disorder (ADHD) may have been protective in an environment that the pregnant mother found stressful because of real physical danger (Glover et al., 2018). Notably, many of today's mental disorders feature disturbed sleep as a symptom. Shorter sleep may have facilitated extra vigilance in offspring, helping them to detect and react more readily to genuine external danger, such as the presence of predators (Glover et al., 2010; Glover et al., 2018).

The importance of maternal depression after the postnatal period

Even compared to prenatal depression, the number of studies that have looked at the impact of concurrent maternal depression on health outcomes in preschoolers is still fewer. Those that have suggest the area deserves at least as much attention as PND. One study found that women with postnatal depression were six times more likely to experience a subsequent depressive episode in the 4 years following birth compared to those without postnatal depression, and that concurrent depressive symptoms were the strongest predictor of preschoolers' behaviour problems (Josefsson & Sydsjo, 2007). Two studies that assessed maternal depressive symptomology across and beyond the postnatal period found the highest rates of clinically significant symptomology at the latest post-birth assessment points; 18 months in one study (Kothari et al., 2016), and 17-21 months in the other (Rosander et al., 2020). The first systematic review of studies assessing the prevalence of maternal depression beyond the first postnatal year was recently published; it identified just 21 studies – highlighting the lack of research in this area (Hunter et al., 2024). The review included studies that assessed maternal depression prevalence anywhere from 1 – 12 years after birth, and assessment points were distributed widely across this period. Depression prevalence was reported five times for the mothers of 3–4-year-olds, with rates ranging from 12.4% to 41.4%. Just seven of the studies analysed the prevalence of depression at multiple timepoints and, of those, all but two reported that prevalence increased over time (Hunter et al., 2024). Also emphasizing the need to look beyond the postnatal period, NZ research indicates maternal depression may in fact be lower in the immediate months following birth than during pregnancy or in the years that follow (Ladyman et al., 2021), perhaps related to the relatively comprehensive care through the Well Child Tamariki Ora public health programme.

Not only does maternal depression remain prevalent after the postnatal period, but it also maintains associations with child health outcomes – likely in the bidirectional manner proposed by socio-ecological models of sleep health and in other research (Dias & Figueiredo, 2021; Meltzer et al., 2021; Sadeh & Anders, 1993; Sadeh et al., 2009). Study Two revealed strong associations

between maternal depression and preschooler sleep problems – both clinically significant and maternally perceived. These associations remained significant after controlling for pre- and postnatal depression, although the effect size was small, possibly due to the stability of maternal depression across the assessment period. A Brazilian cohort study has also demonstrated a cross-sectional relationship between maternal depression and sleep in older preschoolers (aged 4-5 years; Schultz et al., 2020). The study looked exclusively at sleep duration (not sleep problems) and found the children of mothers with moderate-severe depressive symptoms had almost 4x increased odds of regularly attaining less than the recommended 10 hours of sleep/day after controlling for potential confounds (but not pre- or postnatal depression). Though the specific domain of sleep implicated is different in this study than our own – likely a result of significant methodological differences – our combined results underscore the need to extend maternal depression support to at least the first 3-4 years following birth.

Contribution 3: Support for social determinants explanations of sleep health inequities

Arguably the most important outcome of this thesis is its advancement of NZ sleep health literature and contribution to the discourse on social determinants explanations for health inequities. In Study One, there were no differences in key markers of sleep development (night waking and LSRSP) between the infants of Māori and non-Māori mothers, but prior research within *Moe Kura* demonstrates that inequities exist by the time the children are preschoolers. How then, do they develop? The results from Study One suggest factors (and disparities) related to sleep location are important contributors.

Independent associations were found in the analyses of sleep location in relation to both ethnicity and sleep outcomes. While maternal ethnicity was not associated with infant night waking or LSRSP, bedsharing was strongly associated with these key markers of sleep development, and with maternal ethnicity. It is important to acknowledge that reasons for bedsharing were not

assessed and it is well established that bedsharing is practiced by informed choice for a variety of reasons. These reasons include culture or tradition; to facilitate breastfeeding, attachment/bonding, monitoring, or sleep; for comfort (maternal or infant); due to disagreement with recommendations; and out of instinct (Barry & McKenna, 2022; Ward, 2015). However, bedsharing is also practiced for reasons other than informed choice, including "out of desperation" as the only means to stop an infant crying (Barry & McKenna, 2022), and for reasons related to deprivation.

It is well established in the current research and elsewhere, that in NZ, deprivation is disproportionately experienced by Māori. Tipene-Leach et al. (2010) found that due to inequitable access to healthcare, NZ Māori are less aware of safety recommendations than their European counterparts. Internationally, deprivation-related reasons for bedsharing identified in meta-analyses include financial and/or space constraints, protection from violence in the home or neighbourhood, and to maintain infant warmth in an underheated environment (Barry & McKenna, 2022; Ward, 2015). In NZ, Māori are disproportionately affected by all of these factors, due to the ongoing effects of colonisation and racism (interpersonal and institutional), and the sequelae of historic injustices that contribute to intergenerational trauma (Dhunna et al., 2021; Ricci Harris et al., 2006; Marie et al., 2014; Muller et al., 2024; Stats NZ, 2020). Importantly, it is not claimed that that deprivation accounts for all bedsharing among marginalised groups, but that deprivation drivers are more prominent in these groups than in groups of relative privilege, the latter of whom characterise much of the research in this field.

In Study One, bedsharing was associated with Māori ethnicity and high deprivation. Though an ethnicity x NZDep interaction term was not included in the analyses, the results suggest bedsharing was particularly prevalent among Māori of low SEP; a group that is well established as experiencing significant disadvantage in NZ society (see Chapter 1). Aside from the significant safety risks this poses to tamariki Māori, explored extensively elsewhere (Baddock et al., 2017;

McGarvey et al., 2006; Tipene-Leach et al., 2018; Tipene-Leach et al., 2010), the associations found between ethnicity and bedsharing, and bedsharing and sleep outcomes could help explain the sleep health inequities that emerge over time. Those who bedshare by informed choice may have the flexibility to transition to other sleeping arrangements when bedsharing no longer meets their needs. In contrast, the privilege of choice is often not afforded to marginalised groups, therefore marginalised parents may bedshare for longer, against their preference. Associations between bedsharing (and even room-sharing; also associated with Māori ethnicity and high deprivation in Study One) and less consolidated sleep appear to compound over time and may ultimately contribute to sleep health inequities seen in preschoolers (Hoyniak et al., 2022; Kim et al., 2017; Lee et al., 2019; Muller, Paine, et al., 2020; Paul et al., 2017). Deprivation-related factors can also contribute directly, as suggested by socio-ecological models of sleep health (Meltzer et al., 2021; Sadeh et al., 2009). Caregiver experiences of racism (Shepherd et al., 2017), neighbourhood crime (Mayne et al., 2021), and poor housing conditions (Chung et al., 2014; Hoyniak et al., 2022) are all associated with adverse child sleep health outcomes. Moreover, these childhood factors appear to have lasting impact. One study found neighbourhood safety in childhood partially explained sleep health disparities between Black and White American young adults (Fuller-Rowell et al., 2021).

In synthesising the two studies presented in this thesis with existing research, we are reminded that social determinants of health exert their influence long before birth and continue to compound over time. The historical and contemporary sequelae of colonisation have produced entrenched social inequities for Māori, who have been overrepresented in the most socioeconomically deprived neighbourhoods since the first NZDep data was gathered decades ago (Crampton, 2020). As a result, wahine Māori are more likely than non-Māori women to experience many adverse health outcomes, including PND (Clapham et al., 2024; Signal et al., 2017). These findings indicate that, as a result, tamariki Māori are at higher risk of shorter-than-recommended sleep even before birth. After birth, the predispositions for short sleep

programmed by exposure to maternal depression, may be further compounded by the same social determinants that precipitated the prenatal depression. Once short sleep outcomes are established, institutional and interpersonal racism in our health and education systems mean tamariki Māori are less likely than their non-Māori peers to receive appropriate support for any subsequent academic or health problems that follow (Bishop et al., 2009; Ricci Harris et al., 2006). The systemic injustice surrounding sleep health is difficult – yet essential – to fathom. Recognising this injustice compels us to understand that sleep health outcomes, like most health outcomes, are not produced within the health sector and therefore cannot be fully addressed within our public health and medical systems (Jones et al., 2009). Addressing the social determinants requires policy action across all sectors of government, including education, justice, housing, and community development. In parallel with this critical mahi (work), maternal mental health, particularly of wāhine Māori and other Indigenous women, must be well supported through appropriate community and clinical interventions.

7.3 Clinical Implications

The research presented in this thesis has several clinical implications. First, the provision of normative data on infant sleep can assist maternal and child healthcare providers, including lead maternity carers (LMCs) and childbirth educators, in setting realistic expectations for parents, which may reduce parental distress and decrease strain on presently under-resourced healthcare services. Second, the findings highlight the need to incorporate routine depression screening into existing prenatal – ideally preconception – care. Screening for maternal depression should continue after the postnatal period, for the duration of well child programmes. In NZ, the Well Child Tamariki Ora programme provides publicly funded health checks and services for children aged 0 – 5, and so is well placed to incorporate this additional screening. Additionally, these findings suggest clinicians should screen for maternal depression when families present with preschooler sleep problems. The toll child sleep difficulties can take on parents should never be

underestimated. Of course, identifying depression is just the first step in addressing the broader needs of mothers and their children. Onward referral pathways must be clear, accessible, and fit for purpose. Finally, and expanding on this point, this thesis emphasizes the need for public health policies to address institutional racism and other social determinants of health, and for clinical interventions that meet the unique needs of Māori to be funded as a priority.

7.4 Strengths

Key strengths of this thesis extend from the many strengths of the broader *Moe Kura* research project, particularly with regards to its participants and prospective design. First, both studies presented in this thesis had large samples with good Indigenous Māori representation, and with socioeconomic diversity broadly reflective of the NZ population. Māori represented 35.3% and 30.6% of the samples in Studies One and Two, respectively; approximately 2x the proportion of Māori in the general population (16.5%; (Stats NZ, 2019b)). As described in Chapters 1 and 4, this intentional 'over-representation' was integral to the Kaupapa of *Moe Kura* and is in line with research guidelines that recommend the inclusion of subgroups large enough to permit sufficient statistical power for subgroup analysis (Routen et al., 2022). The Kaupapa Māori research principle of *equal explanatory and analytical power for Māori and non-Māori* was upheld in most analyses in Study One, in the descriptions of infant sleep. There was insufficient power to conduct separate analyses for Māori after the introduction of additional constructs of interest, namely perceived sleep problem in Study One, and maternal depression in Study Two. In these analyses ethnicity and SEP were instead included as covariates in order to understand whether ethnicity per se is associated with sleep outcomes, versus social determinants of health.

More broadly, this sample diversity not only improves the generalisability of the findings, but it also supports the studies' statistical power. As discussed throughout this thesis, social determinants of health are central to explaining adverse outcomes, including maternal

depression. Without sufficient sample diversity, it is unlikely that many of the key findings presented here would have been detectable. Indeed, previous research that has looked at maternal depression in homogenous samples has failed to detect significant effects on child sleep (Tikotzky et al., 2021). Second, the extended, prospective design of *Moe Kura* enabled investigation beyond the timeframes that characterise much of the research in this field. Study Two adds to just a handful of studies examining the impact of maternal depression on child sleep outcomes within and beyond the postnatal period. Moreover, to the author's knowledge, this is the only study to consider associations between prenatal depression and preschooler sleep, after controlling for both postnatal and concurrent maternal depression.

Other strengths of this thesis pertain to its broad theoretical and clinical implications. The large sample enabled sufficient statistical power to explore several of the socioecological factors relevant to child sleep health, according to established models (Meltzer et al., 2021; Sadeh et al., 2009). In doing so, additional evidence emphasizing social determinants of sleep health was provided, underscoring the need to develop both clinical and structural (i.e., policy-based) interventions.

7.5 Limitations

A limitation of the current research was its singular focus on depression, at the exclusion of other forms of maternal mental distress. Effect sizes may have been stronger with the inclusion of maternal anxiety and stress, for example. (Schwarze et al., 2024) explored longitudinal relationships between maternal affective symptoms during pregnancy (depressive symptoms, general anxiety, pregnancy-specific anxiety) and infant self-regulation at 3- and 6 months post-partum. They found relationships between infant self-regulation and all three aspects of maternal mental distress, but the strongest relationship with pregnancy-specific anxiety. The authors reported that pregnancy-specific anxiety had a stronger effect on infant self-regulation, including

sleep problems, than postnatal depression or anxiety symptomology. In line with this finding, Buss et al. (2011) found maternal pregnancy-specific anxiety to be associated with child executive functioning at 6-9 years of age. However, other research finds the effects conferred by maternal depression are greater or equal to maternal anxiety (Field, 2011; Hentges et al., 2020).

This thesis was also limited by the gendered language – primarily 'mothers', 'maternal' and 'women' – used throughout. This language was consistent with the aims of *Moe Kura*, as a study of maternal and child health, however, it is important to recognize that people who are pregnant and/or who experience PND may not always identify as "woman" or "mother". Recent international and local reports draw attention to the dearth of research on the perinatal experiences of trans, nonbinary and takatāpui birth parents, and how modifiable limitations in language and data systems make it difficult or impossible to capture gender identity in many research and clinical settings (Greenfield & Darwin, 2020; Walker, 2022). Unfortunately, the use of secondary data meant this issue could not be addressed in the current thesis. Instead, it is highlighted here as an important limitation, in hopes that inclusive terminology and methodology will be incorporated into future research.

7.6 Future Research

In addition to sustained focus on sample ethnic and socioeconomic diversity, and improved gender-inclusivity, this thesis informs several ideas for future research. Among them, the foetal programming hypothesis could be more thoroughly tested with treatment intervention studies. The effective treatment of prenatal depression could overcome a key methodological barrier in observational studies: the chronicity of maternal depression. Many studies show depressive symptoms are often stable across time, including *Moe Kura*. Ladyman et al. (2021)'s latent class analysis of depressive symptom trajectories of *Moe Kura* women identified two stable trajectories: stable mild and chronic high. This stability limited the ability to directly test the

relative impacts of 'programming' versus 'accumulation' hypotheses in the current research. Similarly, (Toffol et al., 2019) faced challenges assessing sensitive periods due to the stability of depressive symptomology in their cohort. Randomised controlled trials assessing the impact of treatment for maternal depression (e.g., by CBT or other evidenced-based psychological therapy) could have important clinical and theoretical implications. By manipulating intervention timing, one could examine the foetal programming hypothesis against alternate theories. For example, the accumulation hypothesis posits that it is the cumulative exposure to adversity over time, rather than exposure during a specific 'sensitive' period, that is most detrimental to child health and development (Hentges et al., 2020; Sameroff & Seifer, 1995). Notably, while the 'programming' and 'accumulation' frameworks highlight different mechanisms – cumulative burden versus timing of exposure – they are not mutually exclusive and could both contribute to child outcomes. For example, early exposure to maternal depression may create vulnerabilities (supporting the programming hypothesis), which are further compounded by continued exposure (supporting the accumulation hypothesis). Comparing the impact of pre- and postnatal interventions on long term child health outcomes could shed light on the relative importance of these alternate hypotheses. Results showing similar effectiveness would support the accumulation hypothesis, as would a dose-response relationship between child outcomes and duration of lifetime exposure to maternal depression prior to intervention. Conversely, the clear superiority of prenatal intervention would support (but not confirm) foetal programming.

Other ideas for future research provided by this thesis include:

- Further longitudinal research that explores relationships between birth-parent mental health and child sleep outcomes from preconception through later childhood, ideally into adolescence and adulthood.
- The inclusion of child sleep as a mediator in longitudinal research into the impact of PND on broader child/adolescent/adult health outcomes.

- Research focused on the development and assessment of interventions that help to address determinants of sleep health, such as community-based support programmes, or policies aimed at reducing socioeconomic and ethnic disparities.
- Research into reasons for bedsharing, particularly in high deprivation contexts, to understand the nuanced and complex motivations behind this practice, and how it relates to long term child sleep outcomes, and maternal and whānau wellbeing. This is separate from sleep safety, which has been more extensively researched.

7.7 Conclusion

In NZ as elsewhere, infant sleep is highly variable. There was no evidence of ethnic differences in key measures of sleep development, indicating sleep-health inequities evident in prior research emerge somewhere between 3 months and 3 years from exposure to ethnic inequities in social determinants of health. Consistent with socio-ecological models of paediatric sleep health, several factors are related to different dimensions of infant sleep, including maternal depression. The findings suggest the impact of maternal depression on child sleep is more pronounced later in early childhood; most notably, prenatal depressive symptoms were associated with shorter-than-recommended sleep at age 3-4 years, over and above the impact of key maternal demographic variables, prior infant sleep characteristics, and postnatal and parallel maternal depressive symptoms. Findings presented in this thesis echo calls for earlier, better, and more enduring screening and support for maternal depression. They also underscore the need for public policy to address institutional racism and other structural barriers to sleep health for Māori.

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APPENDIX A. STATEMENTS OF CONTRIBUTION

DRC 16

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Mikaela L. Carter
Name/title of Primary Supervisor:	Prof. T. Leigh Signal
In which chapter is the manuscript /published work:	5

Please select one of the following three options:

(●) The manuscript/published work is published or in press

- Please provide the full reference of the Research Output:

Carter, M. L., Paine, S.J, Sweeney, B. M., Taylor, J. E., & Signal, T. L. Characterizing the sleep location, patterns, and maternally perceived sleep problems of the infants of Māori and non-Māori mothers in Aotearoa New Zealand. Sleep Health (in press).

( ) The manuscript is currently under review for publication – please indicate:

- The name of the journal:

- The percentage of the manuscript/published work that was contributed by the candidate:

- Describe the contribution that the candidate has made to the manuscript/published work:

( ) It is intended that the manuscript will be published, but it has not yet been submitted to a journal

Candidate's Signature:	Mikaela Carter Digitally signed by Mikaela Carter Date: 2024.11.08 13:46:52 +13'00'
Date:	08-Nov-2024
Primary Supervisor's Signature:	Leigh Signal Digitally signed by Leigh Signal Date: 2024.11.11 12:22:39 +13'00'
Date:	11-Nov-2024

This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis.

GRS Version 5 – 13 December 2019
DRC 19/09/10

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

GRADUATE RESEARCH SCHOOL

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Name of candidate:	Mikaela L. Carter
Name/title of Primary Supervisor:	Prof. T. Leigh Signal
In which chapter is the manuscript /published work:	6

Please select one of the following three options:

(●) The manuscript/published work is published or in press

- Please provide the full reference of the Research Output:

Carter, M. L., Paine, S-J., Sweeney, B. M., Taylor, J. E., & Signal, T. L. Maternal depressive symptoms in and beyond the perinatal period: Associations with infant and preschooler sleep. Sleep (in press).

( ) The manuscript is currently under review for publication – please indicate:

- The name of the journal:

- The percentage of the manuscript/published work that was contributed by the candidate:

- Describe the contribution that the candidate has made to the manuscript/published work:

( ) It is intended that the manuscript will be published, but it has not yet been submitted to a journal

Candidate's Signature:	Mikaela Carter Digitally signed by Mikaela Carter Date: 2024.11.08 13:49:04 +13'00'
Date:	08-Nov-2024
Primary Supervisor's Signature:	Leigh Signal Digitally signed by Leigh Signal Date: 2024.11.11 12:23:51 +13'00'
Date:	11-Nov-2024

This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis.

APPENDIX B. PRENATAL QUESTIONNAIRE

ID: _____

Sleep and Health during Pregnancy

THIS QUESTIONNAIRE SHOULD BE COMPLETED WHEN YOU ARE 35-37 WEEKS PREGNANT

1. **What is your date of birth?** ..... / ..... / .....
   (day) (month) (year)

2. **When is your baby 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 households 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. Before this pregnancy, 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 last week).

Please write the number of hours here ..... hours

24. In the last week, 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 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

Feelings in pregnancy

33. Please tick the answer which comes closest to how you have felt IN THE LAST 7 DAYS, 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 ☞

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.

APPENDIX C. POSTNATAL QUESTIONNAIRE

ID:_____

Postnatal Sleep and Health

PLEASE COMPLETE THIS QUESTIONNAIRE WHEN YOUR BABY IS 12 WEEKS OLD

1. **What is your 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 you belong to?** *Mark the space or spaces which apply to you.*

❍ New Zealand European ❍ Cook Island Māori ❍ Chinese
❍ Māori ❍ Tongan ❍ Indian
❍ Samoan ❍ Niuean ❍ Other such as DUTCH, JAPANESE, TOKELAUAN. Please state:
.....

5. **Which ethnic group does your baby belong to?** *Mark the space or spaces which apply to you.*

❍ New Zealand European ❍ Cook Island Māori ❍ Chinese
❍ Māori ❍ Tongan ❍ Indian
❍ Samoan ❍ Niuean ❍ 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 households 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)*

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 0 1 2 3 4 5 6 7 Extremely Unhappy **OR** 8 ❍ Not applicable

20. How often is a motor vehicle (not counting motorbikes) available for your use?

Circle the number of days a week

NO DAYS 0 1 2 3 4 5 6 7 EVERY DAY

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

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 ☞

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):

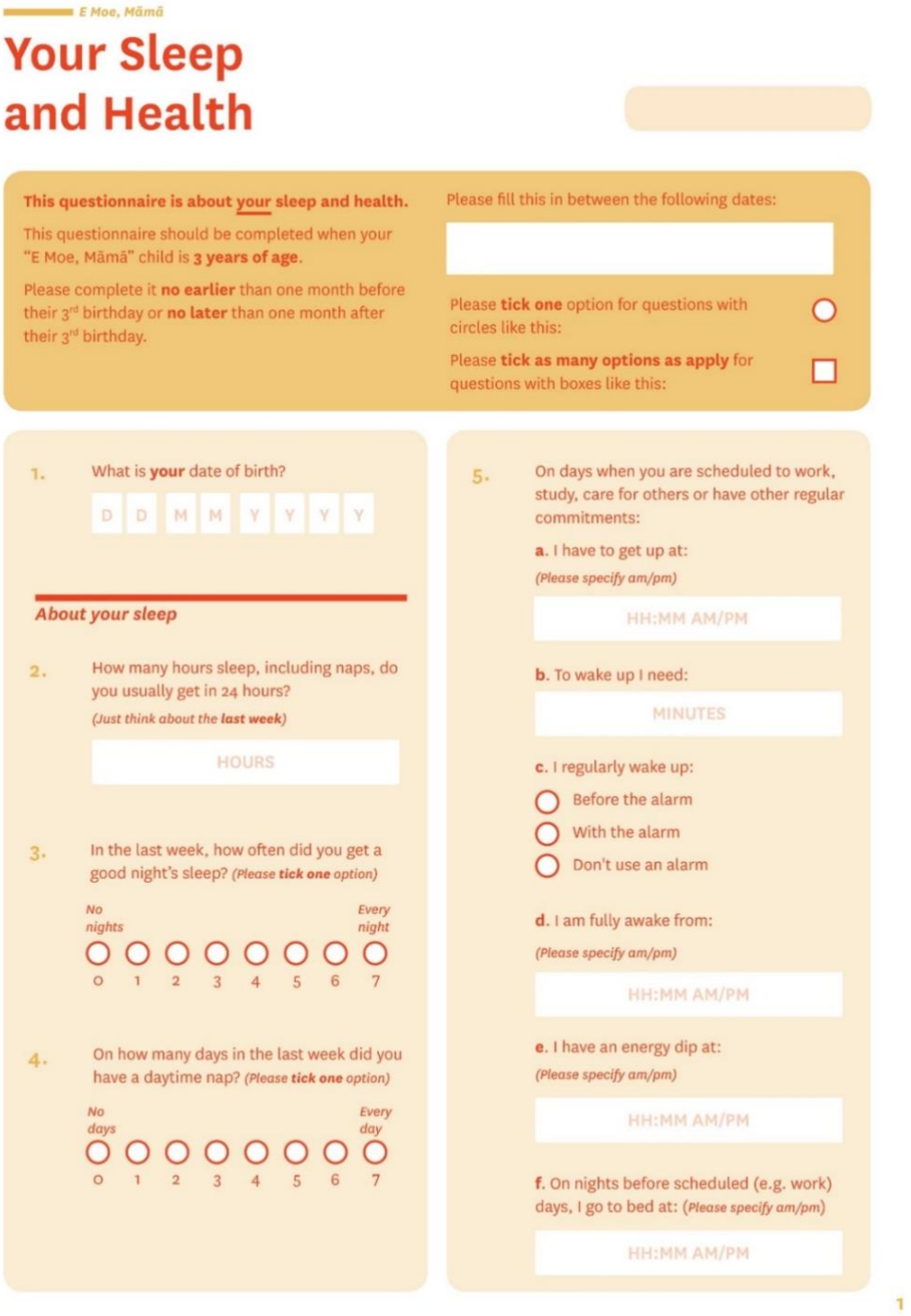
Petrol ☐ (MTA) Supermarket ☐ (New World) Department store ☐ (Farmers)

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.

APPENDIX D. MATERNAL HEALTH QUESTIONNAIRE 3-YEARS POST BIRTH



E Moe, Māmā

Your Sleep and Health

This questionnaire is about your sleep and health.

This questionnaire should be completed when your "E Moe, Māmā" child is **3 years of age**.

Please complete it **no earlier** than one month before their 3rd birthday or **no later** than one month after their 3rd birthday.

Please fill this in between the following dates:

Please **tick one** option for questions with circles like this:

Please **tick as many options as apply** for questions with boxes like this:

1. What is **your** date of birth?

D D M M Y Y Y Y

About your sleep

2. How many hours sleep, including naps, do you usually get in 24 hours?

*(Just think about the **last week**)*

HOURS

3. In the last week, how often did you get a good night's sleep? *(Please **tick one** option)*

No nights — *Every night*

0 1 2 3 4 5 6 7

4. On how many days in the last week did you have a daytime nap? *(Please **tick one** option)*

No days — *Every day*

0 1 2 3 4 5 6 7

5. On days when you are scheduled to work, study, care for others or have other regular commitments:

a. I have to get up at:

(Please specify am/pm)

HH:MM AM/PM

b. To wake up I need:

MINUTES

c. I regularly wake up:

- Before the alarm
- With the alarm
- Don't use an alarm

d. I am fully awake from:

(Please specify am/pm)

HH:MM AM/PM

e. I have an energy dip at:

(Please specify am/pm)

HH:MM AM/PM

f. On nights before scheduled (e.g. work) days, I go to bed at: (*Please specify am/pm*)

HH:MM AM/PM

1

Your Sleep and Health

5. cont'd.

g. To fall asleep when I go to bed takes me:

MINUTES

h. If I get the chance, I like to take a nap:

Yes ◯ No ◯

i. If **yes**, I like to nap at:

(Please specify am/pm)

HH:MM AM/PM

for:

MINUTES

6. Imagine having free days (days when you are **not** scheduled to work, study, care for others or have no other regular commitments). On free days:

a. Ideally, I would sleep in until:

(Please specify am/pm)

HH:MM AM/PM

b. I normally wake up at:

(Please specify am/pm)

HH:MM AM/PM

c. If I wake up at around the normal (scheduled/work day) alarm time, I try to get back to sleep:

Yes ◯ No ◯

d. If I get back to sleep, I sleep for another:

MINUTES

e. I am fully awake from:

(Please specify am/pm)

HH:MM AM/PM

6. cont'd.

f. I have an energy dip at around:

(Please specify am/pm)

HH:MM AM/PM

g. On nights before free days, I go to bed at:

(Please specify am/pm)

HH:MM AM/PM

h. To fall asleep when I go to bed takes me:

MINUTES

i. If I get the chance, I like to take a nap:

Yes ◯ No ◯

j. If **yes**, I like to nap at:

(Please specify am/pm)

HH:MM AM/PM

for:

MINUTES

7. Do you usually watch TV or read in bed before falling asleep?

Yes ◯ No ◯

If you answered 'No' please continue to question 8.

If 'Yes', once I am in bed, I would like to watch TV or read for:

MINUTES

but I normally fall asleep after a maximum of:

MINUTES

Your Sleep and Health

8. Do you prefer to sleep in a completely dark room?

Yes ◯ No ◯

9. Do you wake up more easily when morning light shines into your room?

Yes ◯ No ◯

10. How long on average per day do you spend outside (**really outside**) exposed to daylight?

a: On scheduled days

HOURS & MINUTES

b: On free days:

HOURS & MINUTES

11. Are you an early type (morning) person or a late type (evening) person?

Early type people like getting up early in the morning but have trouble staying up late. Late type people like staying up late but find it hard to get up in the morning.

*(Please **tick one** option on each line)*

	Extreme early type	*Moderate early type*	*Slight early type*	*Neither type*	*Slight late type*	*Moderate late type*	*Extreme late type*
At present, I am	◯	◯	◯	◯	◯	◯	◯
As a child, I was	◯	◯	◯	◯	◯	◯	◯
As a teenager, I was	◯	◯	◯	◯	◯	◯	◯
My mother is/was	◯	◯	◯	◯	◯	◯	◯
My father is/was	◯	◯	◯	◯	◯	◯	◯
My partner* is/was	◯	◯	◯	◯	◯	◯	◯

(boyfriend, girlfriend, spouse, significant other)*

E Moe, Māmā

Your Sleep and Health

0% 100%

12. Are you satisfied with the amount, quality, and timing of your sleep?

◯ Yes ◯ No

Please go to question 13

If 'No', would you like to: *(Please **tick any** that apply)*

- ☐ sleep more
- ☐ sleep less
- ☐ have more refreshing sleep
- ☐ go to sleep earlier
- ☐ go to sleep later
- ☐ get up earlier
- ☐ get up later

13. Thinking about your sleep and sleep habits within **the past month**, how often have you done the following **in the hour** before you went to bed?

	Every night or almost every night	*A few nights a **week***	*A few nights a **month***	*Rarely*	*Never*	*Not applicable*
Did work relating to your job or study	◯	◯	◯	◯	◯	◯
Watched TV/movie	◯	◯	◯	◯	◯	◯
Listened to the radio or music	◯	◯	◯	◯	◯	◯
Were on the computer or internet	◯	◯	◯	◯	◯	◯
Read a book	◯	◯	◯	◯	◯	◯
Had sex	◯	◯	◯	◯	◯	◯
Exercised	◯	◯	◯	◯	◯	◯
Did activities with children	◯	◯	◯	◯	◯	◯
Did activities with family/friends	◯	◯	◯	◯	◯	◯
Drank a caffeinated beverage	◯	◯	◯	◯	◯	◯
Drank an alcoholic beverage	◯	◯	◯	◯	◯	◯
Took a hot bath or shower	◯	◯	◯	◯	◯	◯
Completed household chores	◯	◯	◯	◯	◯	◯

Your Sleep and Health

14. Do you have the following technology in your bedroom?
*(Please **tick as many** boxes as apply)*

- ☐ TV/computer/laptop/ DVD player
- ☐ Smartphone
- ☐ Cellphone (not a smartphone)/pager/Blackberry
- ☐ Gaming console
- ☐ Radio or other music **only** player *(e.g. MP3 player)*
- ☐ e-reader **with** a bright screen *(e.g.Kobo, iPad, other tablet)*
- ☐ e-reader **without** a bright screen *(e.g. non-backlit Kindle)*
- ☐ Other technology *(Please specify)*

PLEASE SPECIFY

- ☐ None

15. How frequently do you do the following in the **hour before** going to sleep?

	Every night or almost every night	*A few nights a **week***	*A few nights a **month***	*Rarely*	*Never*
Watch movies or television *(e.g. on TV, portable DVD player, iPad, laptop, computer)*	○	○	○	○	○
Listen to radio or music *(e.g. using radio, CD or MP3 player)*	○	○	○	○	○
Play games *(e.g. using a computer, phone or gaming console)*	○	○	○	○	○
Read using an e-reader **with** a bright screen *(e.g. Kobo, iPad, other tablet)*	○	○	○	○	○
Read using an e-reader **without** a bright screen *(e.g. non-backlit Kindle)*	○	○	○	○	○
Surf internet or use social media *(e.g. Facebook/texting)*	○	○	○	○	○
Other activities using technology *(Please specify)*	○	○	○	○	○

PLEASE SPECIFY

Your Sleep and Health

16. How frequently do you do the following to help **fall asleep**?

	Every night or almost every night	*A few nights a **week***	*A few nights a **month***	*Rarely*	*Never*
Watch movies or television *(e.g. on TV, portable DVD player, iPad, laptop, computer)*	○	○	○	○	○
Listen to radio or music *(e.g. using radio, CD or MP3 player)*	○	○	○	○	○
Play games *(e.g. using a computer, phone or gaming console)*	○	○	○	○	○
Read using an e-reader **with** a bright screen *(e.g. Kobo, iPad, other tablet)*	○	○	○	○	○
Read using an e-reader **without** a bright screen *(e.g. non-backlit Kindle)*	○	○	○	○	○
Surf internet or use social media *(e.g. Facebook/texting)*	○	○	○	○	○
Other activities using technology *(Please specify)*	○	○	○	○	○

PLEASE SPECIFY

17. Most nights, do you sleep...

*(Please **tick as many** options as you like)*

- ☐ Alone
- ☐ With your partner/significant other
- ☐ With an infant (child under 1 year)
- ☐ With your "E Moe, Māmā" child
- ☐ With other children
- ☐ With a pet
- ☐ Or with someone or something else? *(Please specify)*

PLEASE SPECIFY

Your Sleep and Health

18. How often in the **last week** did you:

*(Please **circle one** number in every row)*

	No days/ no nights							*Every day/ 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
Drink an alcoholic beverage to help you get to sleep	0	1	2	3	4	5	6	7
Use tobacco to help you get to sleep	0	1	2	3	4	5	6	7
Use a herbal product to help you get to sleep	0	1	2	3	4	5	6	7
Use an over-the-counter sleeping pill to help you get to sleep	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 (please specify)	0	1	2	3	4	5	6	7

PLEASE SPECIFY

Your Sleep and Health

19. In the **last week** what, if anything, woke you up during the night?

*(Please **tick as many** options as you like)*

- [ ] Noise
- [ ] Light
- [ ] Stress
- [ ] Too hot or too cold
- [ ] Pain/discomfort
- [ ] Pain/discomfort associated with current pregnancy
- [ ] Nightmares
- [ ] The need to go to the bathroom
- [ ] Wake up for no apparent reason
- [ ] Heartburn
- [ ] Giving care to child
- [ ] Giving care to elderly parent
- [ ] Giving care to someone else
- [ ] Spouse/bed partner
- [ ] Hungry/thirsty
- [ ] Medication side effects
- [ ] Pets
- [ ] Text messages or alerts from phone or other electronic device (not pre-set alarms)
- [ ] Can't breathe comfortably
- [ ] Worrying or thinking about your "E Moe, Māmā" child's behaviour
- [ ] Worrying or thinking about another child's behaviour
- [ ] Worrying or thinking about a disabled or ill family member (adult or child)
- [ ] Worrying or thinking about *current* housing difficulties
- [ ] Worrying or thinking about money/finance problems
- [ ] Worrying or thinking about world or current events
- [ ] Worrying or thinking about balancing work and family
- [ ] Worrying or thinking about family members not getting on
- [ ] Worrying or thinking about who does household chores
- [ ] Something else *(Please specify)* PLEASE SPECIFY
- [ ] Nothing awakens me at night
- [ ] Don't know

Your Sleep and Health

0% 100%

20. During sleep in the **last week,** has anyone told you that you did any of the following? Please circle how often. *(Please **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

21. In the l**ast week**, have you experienced an urge to move your legs (usually accompanied by unpleasant sensations)?

Yes ◯ No ◯

If you answered 'No', please go to question 23.

22. If you answered 'Yes' in question 21, is this:

(Tick all that apply to you)

- ☐ Worse at night?
- ☐ More noticeable when you rest?
- ☐ Relieved by movement?

23. Do you consider that you have a sleep problem?

- ◯ No *(Please go to question 30)*
- ◯ Yes, lasting less than 4 weeks
- ◯ Yes, for 1-6 months
- ◯ Yes, for more than 6 months

COMMENTS WELCOME

24. Please rate the **current (i.e. last 2 weeks) severity** of the following insomnia problem(s):

*(Please **circle one** number in every row)*

	None	*Mild*	*Moderate*	*Severe*	*Very severe*
Difficulty falling asleep	0	1	2	3	4
Difficulty staying asleep	0	1	2	3	4
Problem waking too early	0	1	2	3	4

25. How **satisfied/dissatisfied** are you with your **current** sleep pattern?

*(Please **circle one**)*

Very satisfied	*Satisfied*	*Moderately Satisfied*	*Dissatisfied*	*Very dissatisfied*
0	1	2	3	4

Your Sleep and Health

26. How **noticable** to others do you think your sleeping problem is in terms of impairing your quality of life?

*(Please **circle one**)*

Not at all noticeable	*A little*	*Somewhat*	*Much*	*Very much noticeable*
0	1	2	3	4

27. How **worried/distressed** are you about your current sleep problem?

*(Please **circle one**)*

Not at all worried	*A little*	*Somewhat*	*Much*	*Very much worried*
0	1	2	3	4

28. To what extent do you consider your sleep problem to **interfere** with your daily functioning (e.g. daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc) **currently?**

*(Please **circle one**)*

Not at all interfering	*A little*	*Somewhat*	*Much*	*Very much interfering*
0	1	2	3	4

29. Does your sleep problem interfere with...

	Yes	*No*	*Don't know*	*Not applicable*
Your relationship with your child or children	○	○	○	○
Your relationship with your spouse or partner	○	○	○	○
Caring for your family	○	○	○	○
Your relationship with your extended family or friends	○	○	○	○

30. Have you ever been told by a doctor or other health professional that you have a sleep disorder?

- ○ No *(Please go to question 33)*
- ○ Yes *(Please go to question 31)*
- ○ Don't know *(Please go to question 33)*

31. What was the sleep disorder?

- ○ Obstructive Sleep Apnea
- ○ Insomnia
- ○ Restless legs
- ○ Other *(Please specify)*

PLEASE SPECIFY

- ○ Don't know

Your Sleep and Health

32. What treatments do you now have for your sleep disorder(s)?

*(Please **tick as many** boxes as apply)*

- ☐ No treatment
- ☐ Medicines, tablets or pills
- ☐ Diet
- ☐ Exercise
- ☐ Other *(please specify)* PLEASE SPECIFY
- ☐ Don't know

33. 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	○	○	○	○
Watching TV	○	○	○	○
Sitting inactive in a public place (e.g. movies, meeting)	○	○	○	○
As a passenger in a car for an hour without a break	○	○	○	○
Lying down in the afternoon when circumstances permit	○	○	○	○
Sitting and talking to someone	○	○	○	○
Sitting quietly after a lunch **without** alcohol	○	○	○	○
In a car, while stopped for a few minutes in traffic	○	○	○	○

34. **a.** Thinking about your typical day, what are you unable to do because **you are too sleepy**? Are you too sleepy to: *(Please **tick one circle** on each line)*

	Yes, too sleepy	*No*	*Don't know*
Do job-related work	○	○	○
Spend time with family or friends	○	○	○
Have sex	○	○	○
Do leisure activities such as watching TV or reading	○	○	○
Exercise	○	○	○
Eat right or cook a healthy meal	○	○	○

Your Sleep and Health

34. Cont'd.

b. Thinking about your typical day, what are you unable to do because you **run out of time**? Do you wish you had more time to: *(Please **tick one circle** each line)*

	Yes, run out of time	*No*	*Don't know*
Do job-related work	○	○	○
Spend time with family or friends	○	○	○
Sleep	○	○	○
Have sex	○	○	○
Do leisure activities such as watching TV or reading	○	○	○
Exercise	○	○	○
Eat right or cook a healthy meal	○	○	○

35. How frequently does the sleep of your "E Moe, Māmā" child affect...

*(Please **circle one** number in every row)*

	No nights/ days							*Every night/ day*
Your bed time?	0	1	2	3	4	5	6	7
Your get up time?	0	1	2	3	4	5	6	7
The number of times you wake at night?	0	1	2	3	4	5	6	7
The amount of sleep you get at night?	0	1	2	3	4	5	6	7
How sleepy you are during the day?	0	1	2	3	4	5	6	7
Your mood during the day?	0	1	2	3	4	5	6	7
Your ability to do things during the day?	0	1	2	3	4	5	6	7

36. If you have other children, how much does their sleep affect...

*(Please **circle one** number in every row)*

	No nights/ days							*Every night/ day*
Your bed time?	0	1	2	3	4	5	6	7
Your get up time?	0	1	2	3	4	5	6	7
The number of times you wake at night?	0	1	2	3	4	5	6	7
The amount of sleep you get at night?	0	1	2	3	4	5	6	7
How sleepy you are during the day?	0	1	2	3	4	5	6	7
Your mood during the day?	0	1	2	3	4	5	6	7
Your ability to do things during the day?	0	1	2	3	4	5	6	7

Your Sleep and Health

37. In the past year, how often have you driven a car or motor vehicle while feeling drowsy? Would you say you have driven drowsy...

- ◯ 3 or more times a week
- ◯ 1 to 2 times a week
- ◯ 1 to 2 times a month
- ◯ Less than once a month
- ◯ Never
- ◯ Don't drive/Don't have a license/ Don't have a car
- ◯ Don't know

Where you live and who you live with:

38. Where do you usually live?

NUMBER & STREET NAME

SUBURB OR RURAL DELIVERY NO.

CITY, TOWN OR DISTRICT

POSTCODE

CODE | TELEPHONE NUMBER

CODE | CELLPHONE NUMBER

39. Thinking back over the **past five years,** how many times has your family moved house? *(Please **tick one** option)*

- ◯ Have not moved house in the past 5 years
- ◯ Once
- ◯ Twice
- ◯ Three times
- ◯ Four times
- ◯ Five or more times
- ◯ Don't know

Your Sleep and Health

40. Who normally lives in your household?

Person	Age (Years)	Sex (M/F)	Their relationship to you (e.g. partner, friend, flatmate, parent, grandparent, brother, sister, auntie, uncle, cousin, your child, step-child, another person's child)	Nights per week they normally live there (1-7)	Are you required to care for them? (Y/N)
Me		*F*	*Not applicable*		*Not applicable*
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

Support

41. If you have a partner, how is your relationship with them at the moment?

*(Please **circle one** number)*

Perfectly happy — *Extremely unhappy*

0 1 2 3 4 5 6 7 OR ◯ not applicable

42. Do you have the following types of support?

*(Please **tick one circle** on each line)*

	I don't need any support	*I would like a lot more support*	*I would like some more support*	*I have enough support*
Financial support	◯	◯	◯	◯
Emotional support *(e.g. someone who listens or is 'there' for you)*	◯	◯	◯	◯
Advice *(e.g. someone you can go to for information or guidance)*	◯	◯	◯	◯
Concrete/Practical support *(e.g. childcare, housework, cooking)*	◯	◯	◯	◯

Your Sleep and Health

Income

43. Are **you, yourself** currently receiving any of these types of income support?

(Mark the space or spaces which apply to you)

- ☐ Working for Families (Family Support, In Work Payment, Family Tax Credit)
- ☐ Unemployment benefit
- ☐ Domestic purposes benefit
- ☐ Sickness benefit
- ☐ Invalid's benefit
- ☐ Student allowance
- ☐ Disability allowance
- ☐ ACC (as income support, **not** reimbursement for health services)
- ☐ Other government benefits (independent youth benefit, war pension, etc)
- ☐ None of the above
- ☐ Don't know

44. What is the total income that **you yourself** got from **all sources**, before tax or anything was taken out of it, in the last 12 months?

- ○ Loss
- ○ Zero income
- ○ $1 – $5,000
- ○ $5,001 – $10,000
- ○ $10,001 – $15,000
- ○ $15,001 – $20,000
- ○ $20,001 – $25,000
- ○ $25,001 – $30,000
- ○ $30,001 – $35,000
- ○ $35,001 – $40,000
- ○ $40,001 – $50,000

continues...

44. *Cont'd.*

- ○ $50,001 – $60,000
- ○ $60,001 – $70,000
- ○ $70,001 – $100,000
- ○ $100,001 – $150,000
- ○ $150,001 or more
- ○ Don't know

45. What is the total income that **your household** got from **all sources**, before tax or anything was taken out of it, in the last 12 months?

- ○ Loss
- ○ Zero income
- ○ $1 – $5,000
- ○ $5,001 – $10,000
- ○ $10,001 – $15,000
- ○ $15,001 – $20,000
- ○ $20,001 – $25,000
- ○ $25,001 – $30,000
- ○ $30,001 – $35,000
- ○ $35,001 – $40,000
- ○ $40,001 – $50,000
- ○ $50,001 – $60,000
- ○ $60,001 – $70,000
- ○ $70,001 – $100,000
- ○ $100,001 – $150,000
- ○ $150,001 or more
- ○ Don't know

Your Sleep and Health

46. *The following few questions are designed to identify people who have had special financial needs in the last 12 months. These questions may not apply directly to you, but for consistency we need to ask them of everyone. For each we just require a 'Yes' or 'No' response.*

a. In the last 12 months, did you yourself get income from any of the following sources: Domestic Purposes Benefit, Independent Youth Benefit, Sickness Benefit, Invalids Benefit?

Yes ◯ No ◯

b. In the last 12 months have you personally been forced to buy cheaper food so that you could pay for other things you needed?

Yes ◯ No ◯

c. In the last 12 months, have you been out of paid work at any time for more than one month?

Yes ◯ No ◯

If you answered 'No' to question 46c, please go to question 46e.

d. If you answered 'Yes' in question 46c, was this due to being a full-time care-giver and/or home maker?

Yes ◯ No ◯

e. In the last 12 months have you personally put up with feeling cold to save heating costs?

Yes ◯ No ◯

f. In the last 12 months have you personally made use of special food grants or food banks because you did not have enough money for food?

Yes ◯ No ◯

g. In the last 12 months have you personally continued wearing shoes with holes because you could not afford replacement?

Yes ◯ No ◯

h. In the last 12 months have you personally gone without fresh fruit and vegetables, often, so that you could pay for other things you needed?

Yes ◯ No ◯

i. In the last 12 months have you personally received help in the form of clothes or money from a community organisation (like the Salvation Army)?

Yes ◯ No ◯

Education

47. What is your highest secondary school qualification?

- ◯ None
- ◯ NZ School Certificate in one or more subjects **or** National Certificate Level 1 **or** NCEA Level 1
- ◯ NZ Sixth Form Certificate in one or more subjects **or** National Certificate Level 2 **or** NZ UE before 1986 in one or more subjects **or** NCEA Level 2
- ◯ NZ Higher School Certificate **or** Higher Leaving Certificate **or** NZ University Entrance
- ◯ Bursary/Scholarship **or** National Certificate Level 3 **or** NCEA Level 3 **or** NZ Scholarship Level 4
- ◯ Other secondary school qualification gained in NZ *(Please specify)*

  PLEASE SPECIFY
- ◯ Other secondary school qualification gained overseas

Your Sleep and Health

48. Apart from secondary school qualifications, do you have another completed qualification?

*(Please do not count incomplete qualifications or qualifications that take less than 3 months of full-time study to get. Please tell us your **highest** qualification)*

- ◯ No qualification beyond secondary school
- ◯ Bachelors degree, for example, BA, BSc
- ◯ Bachelors degree with honours
- ◯ Masters degree, for example, MA, MSc
- ◯ PhD
- ◯ Diploma (**not** post-graduate)
- ◯ Diploma – Postgraduate
- ◯ Trade or technical certificate which took more than 3 months full-time study
- ◯ Professional qualification, for example, ACA, teachers, nurses
- ◯ Other *(Please specify)*

PLEASE SPECIFY

49. Are you attending, studying or enrolled at school or anywhere else?

- ◯ Full-time (20 hours or more a week)
- ◯ Part-time (less than 20 hours a week)
- ◯ Neither of these

Paid work

*(These questions refer to your work in the **last week**):*

50. Do you currently work for pay, profit or income?

- ◯ Yes, one paid job
- ◯ Yes, more than one paid job
- ◯ No

COMMENTS WELCOME

If you answered 'No' please go to question 54, if 'Yes' go to question 51.

51. In the **last week**, how many **hours** did you work for pay, profit or income?

HOURS

52. In the **last week**, on how many **nights** did you work for pay, profit or income for at least three hours between midnight and 5am?

*(Please **circle one**)*

No nights *Every night*

0 1 2 3 4 5 6 7

53. Overall how satisfied are you with the balance between your work and other aspects of your life such as time with your family or leisure?

- ◯ Very dissatisfied
- ◯ Dissatisfied
- ◯ Neither satisfied nor dissatisfied
- ◯ Satisfied
- ◯ Very satisfied

Please now go to question 55.

Your Sleep and Health

54. If you are **not** currently working for pay, profit or income, are you at home to care for a child?

- ○ Yes, and I have no plans to return to work
- ○ Yes, and I plan to return to work but have no date in mind
- ○ Yes, I expect to be back at work by

  D D M M Y Y Y Y

- ○ No (please go to question 55)

Ethnicity

55. 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:

  PLEASE SPECIFY

56. Have you ever been a victim of an **ethnically motivated attack** (verbal or physical abuse to the person or property) in New Zealand?

(Mark the space or spaces which apply to you)

- ☐ Yes, verbal - within the past 12 months
- ☐ Yes, verbal - more than 12 months ago
- ☐ Yes, physical - within the past 12 months
- ☐ Yes, physical - more than 12 months ago
- ☐ No
- ☐ Don't know/unsure

57. Have you ever been treated unfairly (for example, kept waiting or treated differently) by a health professional (that is, a doctor, nurse, dentist etc) **because of your ethnicity** in New Zealand?

(Mark the space or spaces which apply to you)

- ☐ Yes, within the past 12 months
- ☐ Yes, more than 12 months ago
- ☐ No
- ☐ Don't know/unsure

58. Have you ever been treated unfairly at work or been refused a job **because of your ethnicity** in New Zealand?

(Mark the space or spaces which apply to you)

- ☐ Yes, within the past 12 months
- ☐ Yes, more than 12 months ago
- ☐ No
- ☐ Don't know/unsure

Your Sleep and Health

59. Have you ever been treated unfairly when renting or buying housing **because of your ethnicity** in New Zealand?

(Mark the space or spaces which apply to you)

- ☐ Yes, within the past 12 months
- ☐ Yes, more than 12 months ago
- ☐ No
- ☐ Don't know/unsure

60. Over the past 12 months, how often have you felt emotionally upset (e.g. angry, sad or frustrated) as a result of **how people of your ethnicity were portrayed in the media** (e.g. newspapers, radio, television, movies)?

- ◯ Never
- ◯ Once or twice in the past year
- ◯ Most months
- ◯ Most weeks
- ◯ Most days

General health and wellbeing

61. What is your weight?

WEIGHT IN KGS

OR

WEIGHT IN STONE/LBS

OR

◯ Don't know

62. What is your height?

HEIGHT IN CENTIMETRES

OR

HEIGHT IN FEET/INCHES

OR

◯ Don't know

63. What is your neck size?

(Please use the tape measure provided to measure around your neck and write the number of centimetres in the space provided)

NECK IN CENTIMETRES

64. Which of the following describes you, if any?

Are you currently pregnant?

Yes ◯ No ◯

Have had another baby (or babies) since your "E Moe, Māmā" baby?

Yes ◯ No ◯

If 'Yes', please specify the dates of birth:

Baby 1

D D M M Y Y Y Y

Baby 2

D D M M Y Y Y Y

Baby 3

D D M M Y Y Y Y

Baby 4

D D M M Y Y Y Y

Your Sleep and Health

65. In general, would you say that your health is:

- ◯ Excellent
- ◯ Very good
- ◯ Good
- ◯ Fair
- ◯ Poor
- ◯ Don't know

66. Are you currently having any **treatment or monitoring** for any of these conditions?

*(Please **tick one circle** on every line)*

	Yes	*No*	*Don't know/ can't remember*
Heart disease	◯	◯	◯
Stroke	◯	◯	◯
Diabetes	◯	◯	◯
Asthma	◯	◯	◯
Arthritis	◯	◯	◯
Spinal disorder	◯	◯	◯
Osteoperosis	◯	◯	◯
Cancer	◯	◯	◯
Anxiety *(Please describe)*	◯	◯	◯
PLEASE DESCRIBE			
Depression	◯	◯	◯
Other mental illness *(Please state)*	◯	◯	◯
PLEASE STATE			
Chronic pain	◯	◯	◯
High blood pressure (hypertension)	◯	◯	◯
High cholesterol	◯	◯	◯
Low iron or anaemia	◯	◯	◯
Allergies	◯	◯	◯
Thyroid problem	◯	◯	◯
Respiratory illness	◯	◯	◯
Other *(Please state)*	◯	◯	◯
PLEASE STATE			

Your Sleep and Health

67. Since your "E Moe, Māmā" baby was born have you been distressed by feelings of anxiety or depression for 2 weeks or more?

Yes ◯ No ◯

If you answered 'No', please go to question 68.

If you answered 'Yes':

a. Were the feelings of anxiety or depression related to the pregnancy or birth of another baby?

Yes ◯ No ◯

b. Did this distress interfere with your ability to get things done or your relationships with family and friends?

*(Please **circle one** number)*

Not at all			*Somewhat*		*Very much*
0	1	2	3	4	5

c. Did this distress lead you to seek professional help?

Yes ◯ No ◯

68. Have you ever been told by a health professional that you had:

Antenatal depression (depression during pregnancy)

No ◯ Yes ◯

If 'Yes', when?

PLEASE SPECIFY WHEN

Postnatal depression (depression after having a baby)

No ◯ Yes ◯

If 'Yes', when?

PLEASE SPECIFY WHEN

68. *Cont'd.* Postpartum psychosis

No ◯ Yes ◯

If 'Yes', when?

PLEASE SPECIFY WHEN

69. 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 70)*

- ☐ 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

Your Sleep and Health

70. Considering the **past 6 months**, would you say that your menstrual cycles (periods) are:

- ◯ Regular (that is, predictable within 1-2 days)
- ◯ Somewhat irregular (that is, predictable between 2–7 days)
- ◯ Irregular (that is, more than 7 days)
- ◯ Unpredictable (that is, skipped a period)
- ◯ Very unpredictable (that is, skipped 2 or more periods in the past 6 months or no period in the past two months)
- ◯ You haven't had a period in the last 12 months
- ◯ Don't know

71. Do you suffer from premenstrual syndrome or PMS?

- ◯ Yes, with symptoms that completely disrupt my life
- ◯ Yes, but with symptoms that have a minor impact on my life
- ◯ No
- ◯ Don't know

72. Is your sleep disturbed during your period compared with other times of your menstrual cycle?

- ◯ Yes
- ◯ No
- ◯ Don't know

73. Is your sleep disturbed during the week before your period compared with other times of your menstrual cycle?

- ◯ Yes
- ◯ No
- ◯ Don't know

74. Do you or your doctor think that:

- ◯ You may be going through peri-menopause, that is, you have changes in your periods but have not gone 12 months in a row without a period
- ◯ You are postmenopausal, or
- ◯ You are neither peri- nor post-menopausal? *(Please go to question 76)*
- ◯ Don't know *(Please go to question 76)*

75. In the **past month**, how many nights did you have a hard time sleeping due to hot flushes or night sweats?

- ◯ Every night or almost every night
- ◯ A few nights a week
- ◯ A few nights a month
- ◯ Rarely
- ◯ Never
- ◯ Don't know

76. **In the last 12 months**, has there been any time when you needed to see a GP about your **own** health, but didn't get to see any doctor at all?

- ◯ Yes
- ◯ No *(Please go to question 80)*
- ◯ Don't know *(Please go to question 80)*

77. How many times has this happened in the past 12 months?

- ◯ One time
- ◯ Two times
- ◯ Three to five times
- ◯ More than five times

Your Sleep and Health

78. The **last time** you were **not** able to see a GP when you needed to, what was the reason you weren't able to?

- ◯ Costs too much
- ◯ Had no transport to get there
- ◯ Lack of childcare
- ◯ Couldn't get an appointment soon enough/at a suitable time
- ◯ It was after hours
- ◯ Couldn't get in touch with the doctor
- ◯ Couldn't spare the time
- ◯ Didn't want to make a fuss
- ◯ Other *(Please specify)*

PLEASE SPECIFY

79. The last time you were **not** able to see a GP, what did you do instead?

- ◯ Nothing
- ◯ Went to see a GP at a later date
- ◯ Phoned Healthline or another phone number for advice
- ◯ Phoned an ambulance
- ◯ Went to Emergency Department at public hospital
- ◯ Went to an after-hours or 24 hour Accident and Medical centre
- ◯ Went to a pharmacy or chemist shop
- ◯ Something else *(Please specify)*

PLEASE SPECIFY

Feelings

80. In the past 30 days how often:

a. Did you feel tired out for no good reason?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

b. Did you feel nervous?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

c. Did you feel so nervous that nothing could calm you down?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

d. Did you feel hopeless?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

Your Sleep and Health

80. *Cont'd.*

In the past 30 days how often:

e. Did you feel restless or fidgety?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

f. Did you feel so restless you could not sit still?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

g. Did you feel depressed?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

h. Did you feel that everything was an effort?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

80. *Cont'd.*

i. Did you feel so sad that nothing could cheer you up?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

j. Did you feel worthless?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little of the time
- ◯ None of the time

Your Sleep and Health

0% 100%

81. Listed below are a few statements about your relationships with others. How much is **each** statement **true or false** for you?

	Definitely true	*Mostly true*	*Don't know*	*Mostly false*	*Definitely false*
I am always courteous even to people who are disagreeable	○	○	○	○	○
There have been occasions when I took advantage of someone	○	○	○	○	○
I sometimes try to get even rather than forgive and forget	○	○	○	○	○
I sometimes feel resentful when I don't get my way	○	○	○	○	○
No matter who I'm talking to, I'm always a good listener	○	○	○	○	○

82. Please indicate how much you agree with the following statements as they apply to you over the **last month**. If a particular situation has not occurred recently, answer according to how you think you would have felt.

	Not at all true	*Rarely true*	*Sometimes True*	*Often true*	*True nearly all the time*
I am able to adapt when changes occur	○	○	○	○	○
I can deal with whatever comes my way	○	○	○	○	○
I try to see the humorous side of things when I am faced with problems	○	○	○	○	○
Having to cope with stress can make me stronger	○	○	○	○	○
I tend to bounce back after illness, injury, or other hardships	○	○	○	○	○
I believe I can achieve my goals, even if there are obstacles	○	○	○	○	○
Under pressure, I stay focused and think clearly	○	○	○	○	○
I am not easily discouraged by failure	○	○	○	○	○
I think of myself as a strong person when dealing with life's challenges and difficulties	○	○	○	○	○
I am able to handle unpleasant or painful feelings like sadness, fear and anger	○	○	○	○	○

Your Sleep and Health

83. Do you describe yourself as a:

(*Please **tick the circle** that applies to you*)

- ◯ regular smoker (I smoke one or more cigarettes per day)
- ◯ occasional smoker (I do not smoke every day)
- ◯ ex-smoker (I used to smoke but not any more)
- ◯ non-smoker (I have never smoked regularly)

84. Does anyone smoke inside your house?

(*Please **tick the circle** that applies to you*)

- ◯ Yes
- ◯ Sometimes
- ◯ No
- ◯ Don't know

85. How many people who live in your household smoke cigarettes? Please count yourself as well

PLEASE SPECIFY

86. Thinking about the car that you usually travel in, does anyone smoke in that car?

◯ Yes ◯ Sometimes ◯ No

87. How often do you drink alcohol? (*Please **tick the circle** that applies to you*)

Never	Less than once a week	Once every 3–7 days	Once every 2 days	Daily
◯	◯	◯	◯	◯

88. On a typical drinking occasion, 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*)

None	Less than 2 drinks	2 to 4 drinks	5 to 6 drinks	More than 6 drinks
◯	◯	◯	◯	◯

89. How often do you use street or recreational drugs, including party pills? (*Please **tick the circle** that applies to you*)

Never	Less than once a week	Once every 3–7 days	Once every 2 days	Daily
◯	◯	◯	◯	◯

90. Date questionnaire completed

D D M M Y Y Y Y

E Moe, Māmā

Your Sleep and Health

0% 100%

You have now completed the questionnaire.

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 $40 voucher, from the choice of three options below, will be posted to you when we receive **both** completed questionnaires. 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)
- ◯ The Warehouse

Important note

If you feel concerned about any of the issues raised by completing this questionnaire, we suggest that you discuss these with your doctor, WellChild/Tamariki Ora provider or other health professional. There is also information available on our website www.mumsleep.co.nz

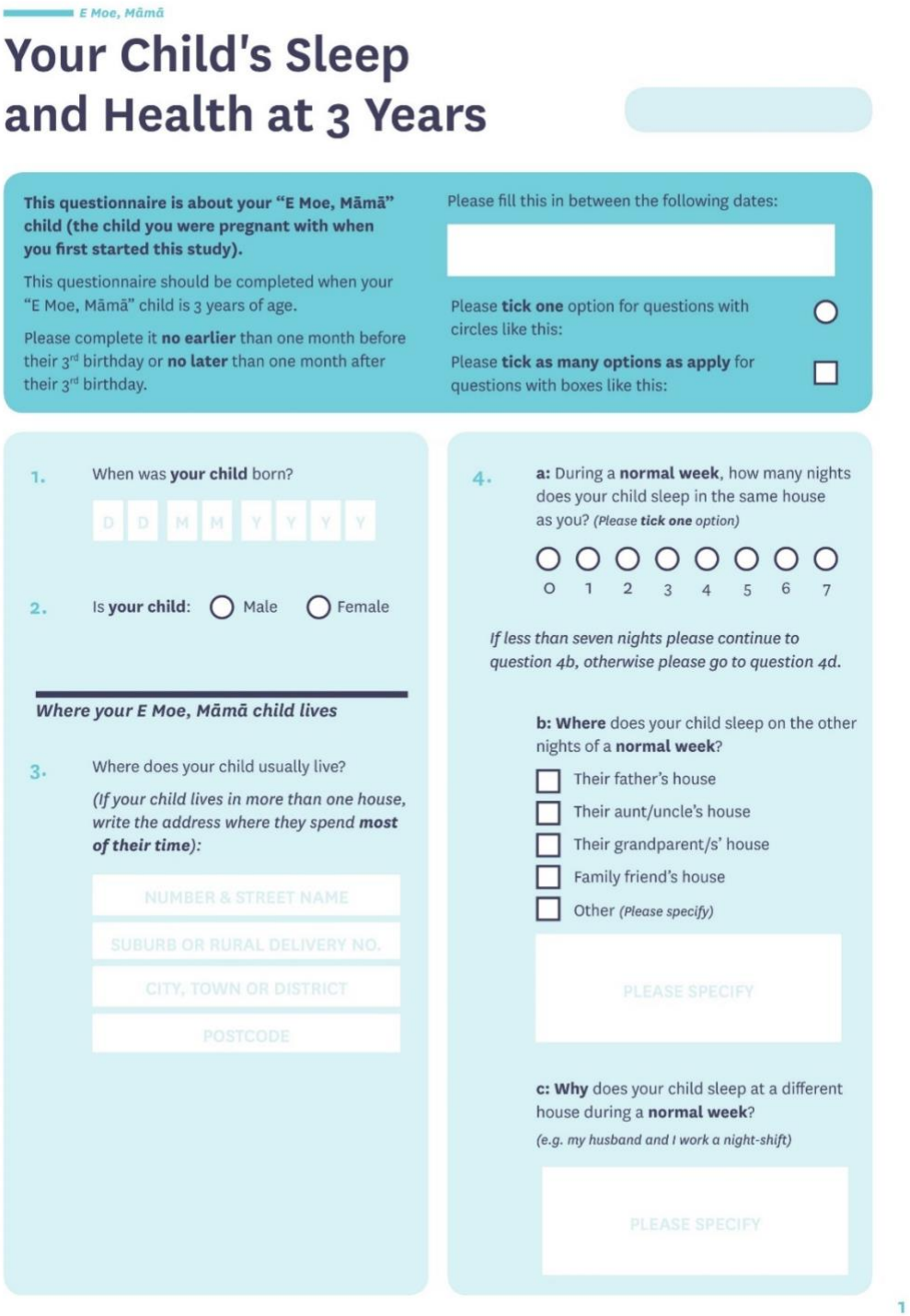
Return to:

Sleep/Wake Research Centre, Massey University, PO Box 756, Wellington 6140 in the reply paid envelope.

If you have lost your envelope, or have any other problems returning the questionnaire, please ring 0800 MUMSLEEP (0800 686 7537) and a member of the research team will assist you.

Thank You!

APPENDIX E. CHILD HEALTH QUESTIONNAIRE 3-YEARS POST-BIRTH



E Moe, Māmā

Your Child's Sleep and Health at 3 Years

This questionnaire is about your "E Moe, Māmā" child (the child you were pregnant with when you first started this study).

This questionnaire should be completed when your "E Moe, Māmā" child is 3 years of age.

Please complete it **no earlier** than one month before their 3rd birthday or **no later** than one month after their 3rd birthday.

Please fill this in between the following dates:

Please **tick one** option for questions with circles like this: ○

Please **tick as many options as apply** for questions with boxes like this: ☐

1. When was **your child** born?

D D M M Y Y Y Y

2. Is **your child**: ○ Male ○ Female

Where your E Moe, Māmā child lives

3. Where does your child usually live?

*(If your child lives in more than one house, write the address where they spend **most of their time**):*

NUMBER & STREET NAME

SUBURB OR RURAL DELIVERY NO.

CITY, TOWN OR DISTRICT

POSTCODE

4. **a:** During a **normal week**, how many nights does your child sleep in the same house as you? *(Please **tick one** option)*

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

If less than seven nights please continue to question 4b, otherwise please go to question 4d.

b: Where does your child sleep on the other nights of a **normal week**?

- ☐ Their father's house
- ☐ Their aunt/uncle's house
- ☐ Their grandparent/s' house
- ☐ Family friend's house
- ☐ Other *(Please specify)*

PLEASE SPECIFY

c: Why does your child sleep at a different house during a **normal week**?

(e.g. my husband and I work a night-shift)

PLEASE SPECIFY

1

Your Child's Sleep and Health at 3 Years

4. *Cont'd.*

d: Are there any other regular **overnight** arrangements to share the care of your child?

(this could be a shared-custody arrangement or an informal agreement)

Yes ○ No ○ Don't know ○

If you answered 'No' or 'Don't know' please go to question 5, if 'Yes' continue to question 4e.

e: What arrangement is that?

(e.g. every second weekend they live with their father)

PLEASE DESCRIBE ARRANGEMENT

Your child's sleep

*When answering the following sleep questions please think only about when your child sleeps at **your house**.*

5. How many **other children** share the room your child sleeps in?

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ more than 5

6. How many **adults** share the room your child sleeps in?

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ more than 5

7. **a:** Where does your child usually sleep?

*(Please **tick as many** boxes as apply)*

- ☐ Own bed
- ☐ Sibling(s) bed
- ☐ Parent(s) bed
- ☐ Other *(Please specify)*

PLEASE SPECIFY

b: How many people usually share the bed with your child?

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ more than 4

If you answered '0' please answer question 7c, otherwise go to question 8.

c: How old was your child when he or she began to sleep alone in their own bed?

YEARS & MONTHS

E Moe, Māmā

Your Child's Sleep and Health at 3 Years

*Questions 8 to 24 ask about your child's sleep habits over the **past seven days**.*

8. What time did your child usually **go to bed**:

a: During the week?
(Sunday night to Thursday night)

HH:MM AM/PM

b: During the weekend?
(Friday and Saturday night)

HH:MM AM/PM

9. What time did your child usually **go to sleep**:

a: During the week?
(Sunday night to Thursday night)

HH:MM AM/PM

b: During the weekend?
(Friday and Saturday night)

HH:MM AM/PM

10. What time did your child usually **wake up**:

a: During the week?
(Monday morning to Friday morning)

HH:MM AM/PM

b: During the weekend?
(Saturday and Sunday morning)

HH:MM AM/PM

11. What is the longest time your child slept in the night **without waking**?

a: During the week?
(Sunday night to Thursday night)

HOURS & MINUTES

b: During the weekend?
(Friday and Saturday night)

HOURS & MINUTES

12. How many naps did your child usually have during the daytime?

a: during the week?
(Monday to Friday)

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 or more

b: during the weekend?
(Saturday and Sunday)

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 or more

c: Is your child transitioning away from napping (now not needing a nap every day)?

- ○ Yes (does not nap every day)
- ○ No (naps every day)
- ○ Has stopped napping completely
- ○ Don't know

Your Child's Sleep and Health at 3 Years

13. How many nights in the last week have you given your child something to help them sleep?

- ◯ 1–2 nights
- ◯ 3–4 nights
- ◯ 5–6 nights
- ◯ 7 nights
- ◯ none at all *(Please go to question 15)*

14. What was used to help your child sleep?

PLEASE SPECIFY

15. Did your child have a snack within the hour before going to bed?

- ◯ Never
- ◯ 1–2 nights a week
- ◯ 3–4 nights a week
- ◯ 5–6 nights a week
- ◯ Every night

16. In the hour before bedtime, did your child engage in stimulating activities such as rough play or sport?

- ◯ Never
- ◯ 1–2 nights a week
- ◯ 3–4 nights a week
- ◯ 5–6 nights a week
- ◯ Every night

17. In the hour before bedtime, did your child engage in relaxing activities such as reading or listening to calming music?

- ◯ Never
- ◯ 1–2 nights a week
- ◯ 3–4 nights a week
- ◯ 5–6 nights a week
- ◯ Every night

18. How often did your child consume foods or drinks containing caffeine after 5pm (such as chocolate, coca-cola, tea, hot chocolate, milo)?

- ◯ Never
- ◯ 1–2 nights a week
- ◯ 3–4 nights a week
- ◯ 5–6 nights a week
- ◯ Every night

19. Did your child typically have a bedtime routine in which the same activities occurred most nights?

Yes ◯ No ◯

20. How many times in the last seven days did your child exercise for more than 20 minutes?

(e.g. swimming, sports, running, skipping, jumping, ball games, scooting, bike riding)

- ◯ Never
- ◯ 1–2 times
- ◯ 3–4 times
- ◯ 5–6 times
- ◯ 7 or more times

Your Child's Sleep and Health at 3 Years

21. Did you usually do any of the following activities with your child at bedtime?

*(Please **tick as many** boxes as apply)*

- ☐ Tell stories to your child
- ☐ Listen to music together
- ☐ Sing to your child
- ☐ Say rhymes or do action songs with your child
- ☐ None of the above
- ☐ Other *(Please specify)*

PLEASE SPECIFY

22. How often was your child read to in the half hour before they went to sleep?

- ◯ Never
- ◯ 1–2 nights a week
- ◯ 3–4 nights a week
- ◯ 5–6 nights a week
- ◯ Every night

23. How often did your child have a bath or shower in the hour before they went to bed?

- ◯ Never
- ◯ 1–2 nights a week
- ◯ 3–4 nights a week
- ◯ 5–6 nights a week
- ◯ Every night

24. How did your child usually fall asleep?

- ◯ With the main lights on
- ◯ With a lamp on
- ◯ With a night light on
- ◯ With a hall light on
- ◯ With no lights on

Technology

25. Does your child have the following technology in their bedroom?

*(Please **tick as many** boxes as apply)*

- ☐ TV/computer/laptop/ DVD player
- ☐ Smartphone
- ☐ Cellphone (not a smartphone)/pager/ Blackberry
- ☐ Gaming console
- ☐ Radio or other music **only** player *(e.g. MP3 player)*
- ☐ e-reader **with** a bright screen *(e.g.Kobo, iPad, other tablet)*
- ☐ e-reader **without** a bright screen *(e.g. non-backlit Kindle)*
- ☐ Other technology *(Please specify)*

PLEASE SPECIFY

- ☐ None

Your Child's Sleep and Health at 3 Years

26. How frequently does your child do the following in the **hour before** going to sleep?

	Every night or almost every night	*A few nights a **week***	*A few nights a **month***	*Rarely*	*Never*
Watch movies or television *(e.g. on TV, portable DVD player, iPad, laptop, computer)*	○	○	○	○	○
Listen to radio or music *(e.g. using radio, CD or MP3 player)*	○	○	○	○	○
Play games *(e.g. using a computer, phone or gaming console)*	○	○	○	○	○
Read using an e-reader **with** a bright screen *(e.g. Kobo, iPad, other tablet)*	○	○	○	○	○
Read using an e-reader **without** a bright screen *(e.g. non-backlit Kindle)*	○	○	○	○	○
Other activities using technology	○	○	○	○	○

PLEASE SPECIFY

27. How frequently does your child do the following to **help them fall asleep**?

	Every night or almost every night	*A few nights a **week***	*A few nights a **month***	*Rarely*	*Never*
Watch movies or television *(e.g. on TV, portable DVD player, iPad, laptop, computer)*	○	○	○	○	○
Listen to radio or music *(e.g. using radio, CD or MP3 player)*	○	○	○	○	○
Play games *(e.g. using a computer, phone or gaming console)*	○	○	○	○	○
Read using an e-reader **with** a bright screen *(e.g. Kobo, iPad, other tablet)*	○	○	○	○	○
Read using an e-reader **without** a bright screen *(e.g. non-backlit Kindle)*	○	○	○	○	○
Other activities using technology	○	○	○	○	○

PLEASE SPECIFY

Your Child's Sleep and Health at 3 Years

Sleep Habits

- The following statements (questions 28 to 32) are about your child's sleep habits and possible difficulties with sleep.
- Think about the **past week** in your child's life when answering the questions.
- If last week was unusual for a specific reason (such as your child had an ear infection and did not sleep well or the TV set was broken), choose the **most recent typical week**.
- Answer USUALLY if something occurs five or more times in a week; answer SOMETIMES if it occurs two to four times in a week; answer RARELY if something occurs never or only one time during a week.
- Please indicate whether or not the sleep habit is a problem by circling "Yes", "No", or "Not applicable" (N/A).

28. Bedtime

	Usually (5–7 nights)	*Sometimes (2–4 nights)*	*Rarely (0–1 nights)*	*Problem? (Please circle)*
Child goes to bed at the same time every night	○	○	○	Yes No N/A
Child falls asleep within 20 minutes after going to bed	○	○	○	Yes No N/A
Child falls asleep alone in bed	○	○	○	Yes No N/A
Child falls asleep in parent's or sibling's bed	○	○	○	Yes No N/A
Child falls asleep with rocking or rhythmic movements	○	○	○	Yes No N/A
Child needs special object to fall asleep *(doll, special blanket, etc)*	○	○	○	Yes No N/A
Child needs parent in the room to fall asleep	○	○	○	Yes No N/A
Child is ready to go to bed at bedtime	○	○	○	Yes No N/A
Child resists going to bed at bedtime	○	○	○	Yes No N/A
Child struggles at bedtime *(cries, refuses to stay in bed, etc)*	○	○	○	Yes No N/A
Child is afraid of sleeping in the dark	○	○	○	Yes No N/A
Child is afraid of sleeping alone	○	○	○	Yes No N/A

29. Sleep behaviour

a: What is your child's usual amount of sleep each **week** day/night, i.e. Sunday to Thursday night? *(combining night time sleep and naps)*

HOURS & MINUTES

b: What is your child's usual amount of sleep each **weekend** day/night, i.e. Friday and Saturday? *(combining night time sleep and naps)*

HOURS & MINUTES

Your Child's Sleep and Health at 3 Years

29. Cont'd.

c: Sleep behaviour

	Usually (5–7 nights)	*Sometimes (2–4 nights)*	*Rarely (0–1 nights)*	*Problem? (Please circle)*
Child sleeps too little	○	○	○	Yes No N/A
Child sleeps too much	○	○	○	Yes No N/A
Child sleeps the right amount	○	○	○	Yes No N/A
Child sleeps about the same amount each day	○	○	○	Yes No N/A
Child wets the bed at night	○	○	○	Yes No N/A
Child talks during sleep	○	○	○	Yes No N/A
Child is restless and moves a lot during sleep	○	○	○	Yes No N/A
Child sleep walks during the night	○	○	○	Yes No N/A
Child moves to someone else's bed during the night *(parent, brother, sister, etc)*	○	○	○	Yes No N/A
Child reports body pains during sleep *(If so, where?)*	○	○	○	Yes No N/A
PLEASE SPECIFY				
Child grinds teeth during sleep *(your dentist may have told you this)*	○	○	○	Yes No N/A
Child snores loudly	○	○	○	Yes No N/A
Child seems to stop breathing during sleep	○	○	○	Yes No N/A
Child snorts and/or gasps during sleep	○	○	○	Yes No N/A
Child has trouble sleeping away from home *(visiting relatives, holiday)*	○	○	○	Yes No N/A
Child complains about problems sleeping	○	○	○	Yes No N/A
Child awakens during night screaming, sweating and inconsolable	○	○	○	Yes No N/A
Child awakens alarmed by a frightening dream	○	○	○	Yes No N/A

30. **Waking during the night**

	Usually (5–7 nights)	*Sometimes (2–4 nights)*	*Rarely (0–1 nights)*	*Problem? (Please circle)*
Child awakes once during the night	○	○	○	Yes No N/A
Child awakes more than once during the night	○	○	○	Yes No N/A
Child returns to sleep without help after waking	○	○	○	Yes No N/A

Please write how many minutes a night wake usually lasts: MINUTES

E Moe, Māmā

Your Child's Sleep and Health at 3 Years

0% 100%

31. Morning waking

	Usually (5–7 mornings)	*Sometimes (2–4 mornings)*	*Rarely (0–1 mornings)*	*Problem? (Please circle)*
Child wakes up by her/himself	○	○	○	Yes No N/A
Child wakes up with alarm clock	○	○	○	Yes No N/A
Child wakes up in negative mood	○	○	○	Yes No N/A
Adults or siblings wake up child	○	○	○	Yes No N/A
Child has difficulty getting out of bed in the morning	○	○	○	Yes No N/A
Child takes a long time to become alert in the morning	○	○	○	Yes No N/A
Child wakes up very early in the morning	○	○	○	Yes No N/A
Child has a good appetite in the morning	○	○	○	Yes No N/A

32. Daytime sleepiness

	Usually (5–7 days)	*Sometimes (2–4 days)*	*Rarely (0–1 days)*	*Problem? (Please circle)*
Child naps during the day	○	○	○	Yes No N/A
Child suddenly falls asleep in the middle of active behaviour	○	○	○	Yes No N/A
Child seems tired	○	○	○	Yes No N/A

During the past week, has your child appeared very sleepy or fallen asleep during the following:

	Not Sleepy	*Very Sleepy*	*Falls Asleep*
Play alone	○	○	○
Watching TV	○	○	○
Riding in car	○	○	○
Eating meals	○	○	○

Going to sleep and staying asleep

*Please think about **your child's sleep in general** when answering questions 33 to 39.*

33. Why do you think your child wakes at night? *(Please **tick as many** boxes as apply)*

- ☐ My child doesn't wake at night
- ☐ Nightmare
- ☐ Sleep walking
- ☐ Sleep talking
- ☐ Night terrors
- ☐ Too hot
- ☐ Too cold
- ☐ Hungry or thirsty
- ☐ Noise
- ☐ Light
- ☐ Pets
- ☐ Breathing difficulties
- ☐ Snoring
- ☐ Other *(Please specify)*

PLEASE SPECIFY

Your Child's Sleep and Health at 3 Years

34. **How often** do you feel the following is a problem for you?
*(Please **tick one** option per statement)*

	Never	*Occasionally*	*1–3 times per week*	*4–6 times per week*	*Every night*
The time it takes my child to fall asleep	○	○	○	○	○
My child's sleeping patterns or habits	○	○	○	○	○

35. **How much** of a problem is the following for you?
*(Please **tick one** option per statement)*

	No problem	*Small problem*	*Moderate problem*	*Large problem*
The time it takes my child to fall asleep	○	○	○	○
My child's sleeping patterns or habits	○	○	○	○

36. Do you feel anxious or worried about...
*(Please **tick as many** boxes as apply)*

- ☐ Your child's bedtime routine
- ☐ How much sleep your child gets
- ☐ Your child's night waking
- ☐ Your child's early waking
- ☐ Other sleep-related behaviour *(Please specify)*

PLEASE SPECIFY

- ☐ None of these

Support and advice

37. Have you sought advice about your child's sleep from a health professional or other provider?

Yes ○ No ○

If 'Yes', which type of health professional/ provider did you seek advice from?
*(Please **tick as many** boxes as apply)*

- ☐ GP
- ☐ Plunket nurse/Well Child provider
- ☐ Paediatrician
- ☐ Homeopath
- ☐ Other *(Please specify)*

PLEASE SPECIFY

Your Child's Sleep and Health at 3 Years

38. Have you followed any tips or tried any particular **techniques or strategies** when it comes to helping your child's sleep?

Yes ◯ No ◯

If 'Yes', please specify which tips/ techniques you have used. Please tick (✓) any strategies that were useful and cross (X) any you tried but did not find helpful

(e.g. ✓ same bedtime every night, x using a nightlight)

PLEASE SPECIFY TECHNIQUES AND IF THEY WERE HELPFUL

39. Which **sources of information** about your child's sleep have you used, and were they useful?

*(Please **tick as many** boxes as apply)*

☐ **Books**
Useful? Yes ◯ No ◯
PLEASE SPECIFY RESOURCE

☐ **Internet**
Useful? Yes ◯ No ◯
PLEASE SPECIFY RESOURCE

☐ **Parenting magazines**
Useful? Yes ◯ No ◯
PLEASE SPECIFY RESOURCE

☐ **Advice from friends/whānau/family**
Useful? Yes ◯ No ◯
PLEASE SPECIFY RESOURCE

☐ **Other** *(please specify)*
Useful? Yes ◯ No ◯
PLEASE SPECIFY RESOURCE

☐ **None**

Your Child's Sleep and Health at 3 Years

Ethnicity

40. Which ethnic group does **your child** belong to?

*Mark the space or spaces which apply to **your child**:*

- ☐ New Zealand European
- ☐ Māori
- ☐ Samoan
- ☐ Cook Island Māori
- ☐ Tongan
- ☐ Niuean
- ☐ Chinese
- ☐ Indian
- ☐ Other such as DUTCH, JAPANESE, TOKELAUAN. Please state:

PLEASE SPECIFY

41. How common are insults or attacks in your neighbourhood to do with someone's ethnicity?

- ◯ Not at all common
- ◯ Not very common
- ◯ Fairly common
- ◯ Very common

42. Has your child ever been treated unfairly **because of his/her ethnicity** in New Zealand?

- ◯ Yes
- ◯ No
- ◯ Don't know

43. Has your child seen someone from their own ethnic group treated unfairly **because of their ethnicity** in New Zealand?

- ◯ Yes
- ◯ No
- ◯ Don't know

If 'Yes', who was this?

(e.g. friend, family member, neighbour)

PLEASE SPECIFY

Your Child's Sleep and Health at 3 Years

Childcare

44. In the **past week**, which type of arranged childcare was your child in, and for how long?

*Please **tick as many options that apply** and write the total hours for each service used in the past seven days.*

- ☐ A babysitter, family member or friend in **my** home
  - TOTAL HOURS IN PAST 7 DAYS
- ☐ A babysitter, family member or friend in **their** home
  - TOTAL HOURS IN PAST 07 DAYS
- ☐ A nanny or early childcare worker in **my** home
  - TOTAL HOURS IN PAST 7 DAYS
- ☐ A nanny or early childcare worker in **their** home
  - TOTAL HOURS IN PAST 7 DAYS

44. *cont'd.*

- ☐ A childcare education centre or crèche
  - TOTAL HOURS IN PAST 7 DAYS
- ☐ A kindergarten
  - TOTAL HOURS IN PAST 7 DAYS
- ☐ Te Kohanga Reo or Pacific Language Group
  - TOTAL HOURS IN PAST 7 DAYS
- ☐ Other childcare arrangement *(Please specify)*
  - PLEASE SPECIFY
  - TOTAL HOURS IN PAST 7 DAYS
- ☐ No arranged care
- ☐ Don't know

45. How old was your child when he/she started to receive the following childcare?

	Age when started receiving childcare	*Don't know*	*N/A*
A babysitter, family member or friend in **my** home	YEARS & MONTHS	○	○
A babysitter, family member or friend in **their** home	YEARS & MONTHS	○	○
A nanny or early childcare worker in **my** home	YEARS & MONTHS	○	○
A nanny or early childcare worker in **their** home	YEARS & MONTHS	○	○
A childcare education centre or crèche	YEARS & MONTHS	○	○
A kindergarten	YEARS & MONTHS	○	○
Te Kohanga Reo or Pacific Language Group	YEARS & MONTHS	○	○
Other childcare arrangement *(Please specify)*	YEARS & MONTHS	○	○

PLEASE SPECIFY

OR

○ My child has never been in any type of childcare

E Moe, Māmā

Your Child's Sleep and Health at 3 Years

0% 100%

Health

46. **What is your child's height and waist measurement?**

*(Using the **tape measure** provided, please measure your child's height and waist **three times**. This helps ensure we have an accurate measure.)*

To measure your child's height:

Please ask your child to take off their shoes and stand flat on the ground with their heels against a wall or door frame.

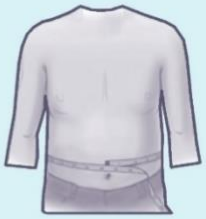
Place your hand, a book, or piece of card flat on their head.

Measure from the point where your hand, book or card touches the wall to the floor (see diagram).

*Write down the height measurement in **cm**.*

Repeat twice more.

To measure your child's waist:



Please ask your child to stand in a relaxed position.

Take the tape measure and pass it around their waist (at the narrowest point) so it sits firmly.

*Write down the waist measurement in **cm**.*

Repeat twice more.

Height	1: HEIGHT IN CM	2: HEIGHT IN CM	3: HEIGHT IN CM
Waist	1: WAIST IN CM	2: WAIST IN CM	3: WAIST IN CM

47. How much does your child weigh **now**?

*(Please record the weight in **kg** that your child is now, if you have access to scales)*

WEIGHT IN KGS

If you do not know how much your child weighs now, please answer question 48.

48. Think about the **last time your child was weighed**:

How much did your child weigh then?

WEIGHT IN KGS

How old was he/she when they were weighed?

YEARS & MONTHS

49. Do you think your child is:

- ◯ Very underweight
- ◯ Underweight
- ◯ Neither underweight nor overweight
- ◯ Overweight
- ◯ Very overweight
- ◯ Don't know

50. In general, would you say your child's health is: *(Please **tick one** option that best describes your child's health)*

- ◯ Poor
- ◯ Fair
- ◯ Good
- ◯ Very good
- ◯ Excellent
- ◯ Don't know

Your Child's Sleep and Health at 3 Years

51. Have you ever been told by a doctor that your child has a health condition that has or is expected to last more than six months, such as those listed below?

*Please **tick as many** boxes as apply*

- ☐ Asthma
- ☐ Eczema
- ☐ Allergy lasting six months or more *(Please specify)*

  PLEASE SPECIFY
- ☐ Birth condition (e.g. spina bifida, congenital heart defect, intellectual disability) *(Please specify)*

  PLEASE SPECIFY
- ☐ Diabetes
- ☐ Cancer *(Please specify)*

  PLEASE SPECIFY
- ☐ Rheumatic heart disease
- ☐ Epilepsy
- ☐ Autism
- ☐ Depression
- ☐ Anxiety
- ☐ Attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD)
- ☐ Permanent hearing problems
- ☐ Vision problems that **cannot be corrected** with glasses
- ☐ Something else *(Please specify)*

  PLEASE SPECIFY
- ☐ Don't know

52. Does anyone smoke **inside your house**?

*(Please **tick one** option)*

- ○ Yes
- ○ No
- ○ Sometimes
- ○ Don't know

53. Thinking about the **car** that your child usually travels in, does anyone smoke in that car?

*(Please **tick one** option)*

- ○ Yes
- ○ No
- ○ Sometimes
- ○ Don't know

Your Child's Sleep and Health at 3 Years

51. Have you ever been told by a doctor that your child has a health condition that has or is expected to last more than six months, such as those listed below?

*Please **tick as many** boxes as apply*

- ☐ Asthma
- ☐ Eczema
- ☐ Allergy lasting six months or more *(Please specify)*

  PLEASE SPECIFY
- ☐ Birth condition (e.g. spina bifida, congenital heart defect, intellectual disability) *(Please specify)*

  PLEASE SPECIFY
- ☐ Diabetes
- ☐ Cancer *(Please specify)*

  PLEASE SPECIFY
- ☐ Rheumatic heart disease
- ☐ Epilepsy
- ☐ Autism
- ☐ Depression
- ☐ Anxiety
- ☐ Attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD)
- ☐ Permanent hearing problems
- ☐ Vision problems that **cannot be corrected** with glasses
- ☐ Something else *(Please specify)*

  PLEASE SPECIFY
- ☐ Don't know

52. Does anyone smoke **inside your house**?

*(Please **tick one** option)*

- ○ Yes
- ○ No
- ○ Sometimes
- ○ Don't know

53. Thinking about the **car** that your child usually travels in, does anyone smoke in that car?

*(Please **tick one** option)*

- ○ Yes
- ○ No
- ○ Sometimes
- ○ Don't know

Your Child's Sleep and Health at 3 Years

Physical functioning

Please think about your child's physical abilities, that is how able they are to perform certain tasks physically, when answering question 54.

54. In the past **one month**, how much of a **problem** has your child had with:

*(Please **tick one** option per statement)*

	Never	Almost never	Sometimes	Often	Almost always
Walking	○	○	○	○	○
Running	○	○	○	○	○
Participating in active play or excercise	○	○	○	○	○
Lifting something heavy	○	○	○	○	○
Bathing	○	○	○	○	○
Helping to pick up his or her toys	○	○	○	○	○
Having hurts or aches	○	○	○	○	○
Low energy level	○	○	○	○	○

Nutrition

55. **a:** Has your child ever been breastfed?

Yes ○ No ○ Don't know ○

If you answered 'Yes' please answer question 55b, if 'No' or 'Don't know' go to question 56.

b: What age was your child when he or she stopped breastfeeding?

*Please write the age your child stopped breastfeeding OR **tick one** option:*

My child stopped breastfeeding at the age of:

YEARS & MONTHS & WEEKS

OR

○ My child is currently breastfed

OR

○ Don't know

56. In the past 7 days, how many mornings has your child eaten breakfast at home?

*(Please **tick one** option).*

- ○ 0 mornings
- ○ 1 morning
- ○ 2 mornings
- ○ 3 mornings
- ○ 4 mornings
- ○ 5 mornings
- ○ 6 mornings
- ○ 7 mornings

Your Child's Sleep and Health at 3 Years

Physical functioning

Please think about your child's physical abilities, that is how able they are to perform certain tasks physically, when answering question 54.

54. In the past **one month**, how much of a **problem** has your child had with:

*(Please **tick one** option per statement)*

	Never	Almost never	Sometimes	Often	Almost always
Walking	○	○	○	○	○
Running	○	○	○	○	○
Participating in active play or excercise	○	○	○	○	○
Lifting something heavy	○	○	○	○	○
Bathing	○	○	○	○	○
Helping to pick up his or her toys	○	○	○	○	○
Having hurts or aches	○	○	○	○	○
Low energy level	○	○	○	○	○

Nutrition

55. **a:** Has your child ever been breastfed?

Yes ○ No ○ Don't know ○

If you answered 'Yes' please answer question 55b, if 'No' or 'Don't know' go to question 56.

b: What age was your child when he or she stopped breastfeeding?

*Please write the age your child stopped breastfeeding OR **tick one** option:*

My child stopped breastfeeding at the age of:

YEARS & MONTHS & WEEKS

OR

○ My child is currently breastfed

OR

○ Don't know

56. In the past 7 days, how many mornings has your child eaten breakfast at home?

*(Please **tick one** option).*

- ○ 0 mornings
- ○ 1 morning
- ○ 2 mornings
- ○ 3 mornings
- ○ 4 mornings
- ○ 5 mornings
- ○ 6 mornings
- ○ 7 mornings

Your Child's Sleep and Health at 3 Years

Development

57. How old was your child when they first crawled?

MONTHS

58. How old was your child when they took their first steps?

YEARS & MONTHS

59. Answer all items as best you can even if you are not absolutely certain. Please give your answers on the basis of your child's behaviour over the **last 6 months**.

*For each item listed in this question, please **tick one** option.*

	Not true	*Somewhat true*	*Certainly true*
Considerate of other people's feelings	○	○	○
Restless, overactive, cannot stay still for long	○	○	○
Often complains of headaches, stomach-aches or sickness	○	○	○
Shares readily with other children, for example toys, treats, pencils	○	○	○
Often loses temper	○	○	○
Rather solitary, prefers to play alone	○	○	○
Generally well behaved, usually does what adults request	○	○	○
Many worries or often seems worried	○	○	○
Helpful if someone is hurt, upset or feeling ill	○	○	○
Constantly fidgeting or squirming	○	○	○
Has at least one good friend	○	○	○
Often fights with other children or bullies them	○	○	○
Often unhappy, depressed or tearful	○	○	○
Generally liked by other children	○	○	○
Easily distracted, concentration wanders	○	○	○
Nervous or clingy in new situations, easily loses confidence	○	○	○
Kind to younger children	○	○	○
Often argumentative with adults	○	○	○
Picked on or bullied by other children	○	○	○
Often offers to help others (parents, teachers, other children)	○	○	○
Can stop and think things out before acting	○	○	○
Can be spiteful to others	○	○	○
Gets along better with adults than with other children	○	○	○
Many fears, easily scared	○	○	○
Good attention span, sees work through to the end	○	○	○

Your Child's Sleep and Health at 3 Years

60. Overall, do you think that your child has **difficulties** in one or more of the following areas: emotions, concentration, behaviour or being able to get on with other people?

- ◯ No → *If you answered 'No' please go to question 65*
- ◯ Yes – minor difficulties
- ◯ Yes – definite difficulties
- ◯ Yes – severe difficulties

→ *If you answered 'Yes' please continue to questions 61–64*

61. How long have these difficulties been present?

- ◯ Less than a month
- ◯ 1–5 months
- ◯ 6–12 months
- ◯ Over a year

62. Do the difficulties upset or distress your child?

- ◯ Not at all
- ◯ Only a little
- ◯ Quite a lot
- ◯ A great deal

63. Do the difficulties interfere with your child's everyday life in the following areas?

	Not at all	*Only a little*	*Quite a lot*	*A great deal*
Home life	◯	◯	◯	◯
Friendships	◯	◯	◯	◯
Learning	◯	◯	◯	◯
Leisure activities	◯	◯	◯	◯

64. Do the difficulties put a burden on you or the family as a whole?

- ◯ Not at all
- ◯ Only a little
- ◯ Quite a lot
- ◯ A great deal

Your Child's Sleep and Health at 3 Years

65. Please reflect on the degree to which each of the following statements currently applies to your relationship with your child.

*Please **tick one** circle on each line.*

	Definitely does not apply	*Not really*	*Neutral, not sure*	*Applies somewhat*	*Definitely applies*
I share an affectionate, warm relationship with my child.	○	○	○	○	○
My child and I always seem to be struggling with each other.	○	○	○	○	○
If upset, my child will seek comfort from me.	○	○	○	○	○
My child is uncomfortable with physical affection or touch from me.	○	○	○	○	○
My child values his/her relationship with me.	○	○	○	○	○
When I praise my child, he/she beams with pride.	○	○	○	○	○
My child spontaneously shares information about himself/herself.	○	○	○	○	○
My child easily becomes angry at me.	○	○	○	○	○
It is easy to be in tune with what my child is feeling.	○	○	○	○	○
My child remains angry or is resistant after being disciplined.	○	○	○	○	○
Dealing with my child drains my energy.	○	○	○	○	○
When my child is in a bad mood, I know we're in for a long and difficult day.	○	○	○	○	○
My child's feelings toward me can be unpredictable or can change suddenly.	○	○	○	○	○
My child is sneaky or manipulative with me.	○	○	○	○	○
My child openly shares his/her feelings and experiences with me	○	○	○	○	○

66. How would you rate your current relationship with your child? *Please **tick one** option.*

Poor	Fair	Good	Very good	Excellent
○	○	○	○	○

67. Date questionnaire completed

D D M M Y Y Y Y

E Moe, Māmā

Your Child's Sleep and Health at 3 Years

You have now completed the questionnaire.

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 $40 voucher, from the choice of three options below, will be posted to you when we receive **both** completed questionnaires. 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)
- ◯ The Warehouse

Important note

If you feel concerned about any of the issues raised by completing this questionnaire, we suggest that you discuss these with your doctor, Well Child/Tamariki Ora provider or other health professional. There is also information available on our website www.mumsleep.co.nz

Return to:

Sleep/Wake Research Centre, Massey University, PO Box 756, Wellington 6140 in the reply paid envelope.

If you have lost your envelope, or have any other problems returning the questionnaire, please ring 0800 MUMSLEEP (0800 686 7537) and a member of the research team will assist you.

Thank You!

APPENDIX F. STUDY ONE SUPPLEMENTARY MATERIALS

Infant sleep variables were developed from multi-choice questionnaire items as follows:

Day [Night] sleep location (room) *Where does your baby sleep most of the time during the DAY [at NIGHT]?* Day response options were: *In his/her own room, In parents' room, In sibling or other's room, In another room of the house, With you or another person e.g., being held or in a sling (day option only), Moving around with you e.g., in a pram or basket (day option only), Other*. ***Day [Night] sleep location (sleep surface)*** What *does your baby sleep in most of the time during the DAY [at NIGHT]?* Response options were: *Bassinet, Cot, Parents' bed, Infant seat, Being held or in sling/front pack (day option only), In a pram or buggy, Other.* Night sleep room and sleep surface variables were combined to provide a more detailed picture of infant sleep location and to facilitate comparisons to existing literature.(Moon et al., 2022) Parent room in cot or bassinet was classified as *room-sharing*; parent room in parent bed was classified as *bedsharing*; own room in cot or bassinet was classified as *independent sleeping*, the remaining categories were *sibling room in cot or bassinet*, and *other*. Due to more variability in daytime sleep location, these response options remained as listed in the questionnaire except for *Cot* and *Bassinet*, which were combined. When generating descriptive statistics each sleep location was analysed separately and coded as 'yes' or 'no', as many respondents selected multiple options to these items. To account for sleep location in our multivariable models, all respondents who selected 'parent bed' in response to the night sleep surface question were classified as bed-sharers and were compared to all others. ***Night sleep location change*** was assessed with the question(s) *In the last week did your baby start their night sleep in one location, and then move to another location during the night? If "Yes", on how many nights did they change their sleep location?*

Items pertaining to infant sleep behaviour (***Night waking, Night LSRSP, Day LSRSP, Help to sleep***), were assessed with the following items, respectively: *How many times does your baby usually wake up between 10pm and 6am (0/not at all, 1, 2, 3, 4 or more times)*; *What is the longest*

stretch of time that your baby is asleep during the night [during the day] without waking up? (Less than 30 min, 30 min-1 hr, 1-2 hr, 2-3 hr, 3-4 hr, more than 4 hr); How often does your baby go off to sleep with help from others? (Never, Rarely, Often, Always). The impact of infant sleep on maternal opportunities for sleep and rest (***Reasonable maternal sleep, Opportunities for maternal daytime breaks***) were respectively assessed with the items *How often do your baby's sleep patterns allow you to get a reasonable, total amount of sleep in 24 hours?* and *How often do your baby's daytime sleep patterns allow you to have a break? (0/no days, 1, 2, 3, 4, 5, 6, 7/everyday).* These levels were collapsed into *0/Never, 1-3 days, 4-6 days, 7/Always*. ***Day-to-day change*** in infant sleep, was assessed with the item *How much do your baby's sleep patterns change from day to day? (Always the same, change occasionally, change often, every day is different).* Finally, to assess maternal perception of infant sleep problems, we used an item from the original BISQ(Sadeh, 2004): *In general, do you consider your child's sleep a problem? (A very serious problem, a small problem, not a problem at all)*. This was dichotomized to create our ***Perceived problem*** variable; affirmative responses were coded as 'yes', the negative response was coded as 'no'.

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APPENDIX H. CLINICAL INTERNSHIP RESEARCH CASE STUDY

Considering Sleep: Characterizing the sleep location, patterns, and maternally perceived problems of Māori and non-Māori infants in Aotearoa New Zealand, and Reflecting on the Implications of this Research for Children with Type 1 Diabetes and their Whānau

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An assessment case study presented in partial fulfilment of the degree of

Doctor of Clinical Psychology

This case study represents the work of Mikaela Carter during her internship within the Endocrine/Diabetes Department and Wellington Hospital. In 2023. Clinical supervision was received during assessment and treatment for the individual described within the case study. All potentially identifiable information, including names, have been changed to protect the anonymity of the client.

Candidate: Mikaela Carter Date: 30 October, 2023

Research Supervisor: Jo Taylor

Abstract

This case study presents an original research article alongside clinical internship reflections that together illustrate some of the myriad relationships between psychological research and clinical practice on the topic of sleep. The aim of the research article was to investigate potential sleep inequities between Māori and non-Māori infants in Aotearoa/New Zealand, identify socio-ecological factors associated with infant sleep, and determine features of infant sleep that contribute to a mother-perceived infant sleep problem. Findings show sleep at 12 weeks of age is associated with numerous socio-ecological factors. These research results support a social determinants explanation for sleep health inequities seen later in childhood. Internship reflection consider these findings in the context of Type 1 Diabetes, where sleep is also impacted by socio-ecological factors, with major implications for physical health and wellbeing.

Introduction

Sleep predicts child development in myriad ways, including physical, cognitive, and emotional development (El-Sheikh & Sadeh, 2015) and is recognized as essential to child health (Marsh et al., 2019). Additionally, both infant sleep and expectations around infant sleep impact maternal wellbeing (Barry, 2021a; Tikotzky et al., 2021). Despite awareness of the importance of sleep for child health and family harmony (Muller et al., 2019b), it is difficult to determine what is normative versus problematic sleep in young infants (e.g., ~12 weeks of age) because few studies have provided detailed descriptions of their sleep-wake characteristics.

In Aotearoa New Zealand (NZ), there are sleep health inequities between Māori, the Indigenous people of NZ, and non-Māori adults, and in children as young as 3-4 years (Paine & Muller, 2023). Health inequities are unjust, modifiable disparities in health between socially or economically disadvantaged groups and their more advantaged counterparts (Braveman, 2014). Early inequities in sleep health are thought to contribute to long-term inequities in wellbeing (Billings

et al., 2021; Muller, Paine, et al., 2022). The primary aim of this study was to explore whether sleep health inequities between the children of Māori and non-Māori mothers are present as early as 12 weeks of age, as this can further our understanding of when and why they develop.

The development of organized sleep-wake patterns occurs as a function of two interacting biopsychosocial processes: consolidation and self-regulation (Goodlin-Jones et al., 2001). Sleep consolidation describes the gradual development of a diurnal sleep pattern, with longer periods of sleep during the night, combined with longer periods of wakefulness during the day.(Goodlin-Jones et al., 2001) Sleep self-regulation refers to an infant's capacity to independently transition between wakefulness and sleep (Goodlin-Jones et al., 2001). Emergence of the circadian timing system at 8-12 weeks helps to initiate these processes (Jenni & Carskadon, 2009), facilitating changes to sleep-wake patterns that are especially rapid in the first year of life and which continue throughout childhood (Galland et al., 2012). Their maturation is marked by fewer signalled night wakings, less reliance on caregivers to initiate or resume sleep, and a greater longest self-regulated sleep period (LSRSP) – i.e., the longest period of "uninterrupted" sleep (as experienced by the caregiver) the infant obtains (Henderson et al., 2011).

Socio-ecological models of sleep health propose several nested layers of factors relevant to infant sleep development (Meltzer et al., 2021). At the most proximal, microsystem-level are factors intrinsic to the infant, such as age. The mesosystem includes parent-child interaction factors, including breastfeeding, bedsharing and family routines, which have bi-directional relationships with parent wellbeing such as mental health, life stress, and partner relationship satisfaction. More distally, SEP is associated with macrosystem factors including housing conditions. SEP has a strong association with health generally (R. Harris et al., 2006), and paediatric sleep health specifically (Paine & Muller, 2023). A further aim of this study was to identify socio-ecological factors associated with infant sleep characteristics, with a focus on sleep location and markers of infant sleep development.

A final aim was to understand how infant sleep and socio-ecological factors relate to maternal perceptions of infant sleep problems. It is important to understand potential drivers of perceived problems, as they index one of the most common reasons for presentation to paediatric services and can be distressing for parents (D'Souza et al., 2023; Goodlin-Jones et al., 2001). Though consolidation and regulation are important processes, it is normal to see large between-child variability in the speed and linearity of these processes (Barry, 2021a; Galland et al., 2012). Historically, paediatric sleep research, at least in western psycho-medical contexts, has been predicated on "sooner the better" assumptions regarding sleep consolidation and regulation (Barry, 2021a; D'Souza & Cassels, 2023; Goodlin-Jones et al., 2001). Several studies have found night waking and shorter LSRSP commonly characterize parent-identified sleep problems (Henderson et al., 2013; Mindell et al., 2022; Sadeh et al., 2011). This contrasts with anthropologically informed perspectives that consider signalled night wakings throughout infancy to be functional, particularly for nutrition and attachment (Ball, 2013; Barry, 2021a; D'Souza & Cassels, 2023).

Irrespective of perspective, previous research indicates one third to one half of parents view their infant's sleep as problematic (Bayer et al., 2007; J. A. Mindell et al., 2017; Sadeh et al., 2011). This points to possible widespread distress given how central sleep is to family wellbeing (Muller et al., 2019b). Understanding how mother-identified sleep problems are characterized for 12-week-old infants may assist in ameliorating that distress, whether by identifying and addressing potential contributing contextual factors, targeting infant sleep behaviours, or helping parents to understand infant sleep, in order to modify expectations and perceptions.

In summary, we know infant sleep health is important and that sleep health inequities are present among NZ adults and children as young as 3-4 years. We do not yet know if these inequities are present in infancy. We also have limited knowledge of the socio-ecological factors associated with infant sleep, and which infant sleep variables characterize a perceived sleep problem. This study

aims to 1) characterize and compare the sleep of 12-week-old infants of Māori and non-Māori NZ women; 2) identify socio-ecological factors associated with infant sleep characteristics; and 3) determine features of infant sleep that contribute to a mother-perceived infant sleep problem.

Methods

Moe Kura: Mother and Child Sleep and Wellbeing in Aotearoa New Zealand *(Moe Kura)* is a longitudinal study investigating the role of sleep in the health and wellbeing of mothers and their children in NZ (Signal et al., 2022). The study followed mothers from late pregnancy to 3 years post birth and collected self-report questionnaire data at four points. The current research involved cross-sectional, secondary analyses of a subset of survey data collected at 12 weeks postpartum from 2010-2012.

All aspects of the study are informed by Kaupapa Māori research principles described in detail elsewhere (Signal et al., 2022) but briefly include: (1) Māori participation and control at all levels and stages of the research; (2) appropriate collection of ethnicity data to identify and monitor health disparities; and (3) equal explanatory and analytical power for Māori and non-Māori. This research is covered by the study's ethical approval (HDEC; CEN 09/09/070).

Variables

Sleep Measures. Infant sleep variables were developed from multi-choice questionnaire items based on the original Brief Infant Sleep Questionnaire (Sadeh, 2004) (see supplementary materials for sleep variable development details). Questions on night waking used the 10pm – 6am timeframe proposed by Henderson et al. (2011). Based on response distributions, most outcome variables were subsequently dichotomized *(Bedsharing, Room-sharing* and *Independent sleeping* all Yes/No; *Night LSRSP:* ≤ 4 hr vs. > 4 hr*; Night Location Change:* ≥ 1 time/week vs. never*; Opportunity for maternal daytime breaks:* 0-3 vs. 4-7 days/week*;* opportunities for reasonable maternal sleep *(Reasonable mat. Sleep):* 0-3 vs. 4-7 days/week; Infant has help from others to go

to sleep *(Help to sleep)*: often/always vs. rarely/never; *Day to Day Change* or *Consistency* in Infant Sleep Patterns: always different/frequent change vs. occasional change/always the same); *Sleep Problem:* Yes (serious or small) vs. No (not a problem at all). Due to their response distributions, two variables were coded into 4 categories: *Night Waking* (0, 1, 2, 3+ wakings) and *Daytime LSRSP* (< 1, 1-2, 2-3, >3 hours).

Maternal sleep duration was measured by a single item asking mothers to provide a past week estimate: "How many hours sleep, including naps, do you usually get in 24 hours?". Maternal sleep quality was measured with the Sleep Quality Subscale of the General Sleep Disturbance Scale (Lee, 1992), with the total score prepared as a continuous variable.

Maternal Ethnicity. Participating mothers self-identified their own ethnicity based on responses to the 2001 New Zealand Census question: *"Which ethnic group do you belong to? Mark the space or spaces which apply to you".* Participants were categorized as Māori if they identified as Māori alone or in combination with another ethnic group(s), with all others categorized as non-Māori (Stats NZ, 2019a).

Covariates. SEP was measured at 12 weeks postpartum using the New Zealand Index of Deprivation (NZDep2006; Salmond et al., 2007). This is a widely used area-based measure of relative socioeconomic deprivation in NZ based on nine census variables, with higher deciles indicating greater deprivation. Consistent with other research (Vaipuna et al., 2018), these deciles were collapsed into three levels of socioeconomic deprivation: low (deciles 1-3), medium (deciles 4-7), and high (deciles 8-10). Other covariates included maternal age (years), parity (primiparous or multiparous), infant age (weeks), infant ethnicity (Māori or non-Māori, as identified by the mother), breastfeeding status (exclusive breastfeeding, i.e.,, infants who had only ever received breastmilk versus all others). The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, et al., 1987) was used to measure current symptoms of maternal depression, with the total score prepared as a continuous variable. Life stress was measured with the Life Stress scale from the

Pregnancy Risk Assessment Monitoring System (PRAMS; Shulman et al., 2018) High stress was defined as ≥2 stressors, in line with prior studies (Ladyman et al., 2021; Signal et al., 2017). Partner relationship satisfaction was measured on an 8-point Likert-type scale (range 0-7; where, consistent with Ladyman et al. (2021), < 3 indicated greater satisfaction and ≥ 3 indicated less satisfaction or not applicable. Work status was measured with a single item asking if the participant currently works for *pay, profit or income.* Responses were *No; Yes, one paid job;* or *Yes, more than one paid job;* dichotomized to No/Yes.

Data Analysis

Analyses were conducted using IBM SPSS (Version 28).

Descriptive analyses. Bivariate associations with infant and maternal age were analysed using independent t-Tests; Chi-Square tests were used for all other categorical variables.

Multivariable analyses. The relative impact of different socio-ecological factors on sleep outcome variables were assessed with multivariable logistic regression models. Ordinal logistic regression was used for *Night Waking* and *Daytime LSRSP. Bedsharing* (nighttime bedsharing vs. all other night sleep locations) was examined as both an outcome variable (what factors are associated with bedsharing?) and a co-variate (is bedsharing associated with other sleep outcomes?). Independent variables were consistent across all models, except for the 'Sleep Problem' model, which included infant sleep outcomes as independent variables and additional variables pertaining to maternal sleep (duration and quality).

Results

Table 5.1 details sample demographics and infant sleep characteristics by maternal ethnicity.

Sample Demographics

Māori mothers were younger, with a greater proportion living in more deprived areas, compared to non-Māori mothers. Infant age ranged from 6-22 weeks; however, the standard deviation was relatively small (1.3 and 0.97 weeks for Māori and non-Māori, respectively), indicating more than 90% of mothers completed the survey within the requested timeframe (when infants were 11-13 weeks old). There was no difference in infant age based on maternal ethnicity. Most infants belonged to the same ethnic group as their mothers, however, 3.4% of Māori mothers had non-Māori infants, and 8.3% of non-Māori mothers had Māori infants.

Sleep Location

At night, both room-sharing and bedsharing was more common among Māori than non-Māori mothers. Non-Māori mothers were more likely to report independent (i.e., own room) infant sleep, and they were also more likely to report never changing their infant's sleep location overnight. During the day, approximately three quarters of infants slept in a cot or bassinet, this did not differ by ethnicity. Conversely, ethnic differences were seen in other day sleep locations and surfaces.

Infant Sleep Patterns

Nearly half of mothers reported their infants woke once between 10pm and 6am (Māori (M) 46.5%, non-Māori (nM) 45.9%), around one quarter reported waking twice, 16% reported no wakings, and 8%-10% reported ≥ 3 wakings. Most mothers reported nighttime LSRSP greater than 4 hr (M 85.9%, nM 87.4%). There were no differences in number of night wakings or night LSRSP by ethnicity. However, Māori mothers were more likely to report longer (> 3 hr) daytime LSRSP, and non-Māori mothers were more likely to report shorter daytime LSRSPs (< 1 hr and 1-2 hr).

Table 7.1: *Sample demographic and descriptive data on infant sleep location and patterns by maternal ethnicity*

	Māori	non-Māori	p
Demographic characteristics			
Sample n (%)	383 (35.3)	702 (64.7)	
Maternal age *years*, mean (SD, range)[a]	28.41 (6.32, 16-43)	32.08 (5.21, 16-46)	**< .001**
Infant age *weeks*, mean (SD, range)[a]	12.09 (1.3, 6-22)	12.17 (0.97, 9-21)	.345
Infant ethnicity, % (95% CI)			**< .001**
Māori	96.6 (94.4-98.1)	8.3 (6.4-10.5)	
non-Māori	3.4 (1.9-5.6)	91.7 (89.5-93.6)	
NZDep Level, % (95% CI)			**< .001**
Low (1-3)	15.2 (11.9-19.1)	39.7 (36.1-43.3)	
Medium (4-7)	38.8 (34.1-43.8)	42.7 (39.0-46.3)	
High (8-10)	45.9 (41.0-51.0)	17.7 (15.0-20.6)	
Infant sleep characteristics, % (95% CI)			
Night sleep location			
Room-sharing	66.1 (61.2-70.7)	48.3 (44.6-52.0)	**< .001**
Bedsharing	14.4 (11.1-18.1)	5.4 (3.9-7.3)	**< .001**
Independent sleep (own room)	19.8 (16.1-24.1)	42.2 (38.6-45.8)	**< .001**
In sibling or other room, in cot or bassinet	2.1 (1.0-3.9)	0.9 (0.4-1.8)	.085
Other	1 (0.4-2.5)	0.9 (0.4-1.8)	.755
Day sleep location (room)			
Parent Room	47.9 (42.9-52.9)	32.5 (29.1-36.0)	**< .001**
Own room	21.7 (17.8-26.1)	39.6 (36.0-43.3)	**< .001**
Sibling or other's room	0.5 (0.1-1.7)	0.4 (0.1-1.1)	.814
Another room of the house	18.0 (14.4-22.1)	9.3 (7.3-11.6)	**< .001**
With mum or another person (e.g., Being held, sling)	13.2 (10.1-16.9)	9.0 (7.0-11.3)	**.029**
Moving around with mum (e.g., In pram or basket)	18.0 (14.4-22.1)	17.5 (14.8-20.5)	.848
Day sleep location (sleep surface)			
Bassinet or cot	72.6 (68.0-76.9)	73.6 (70.3-76.8)	.706
Parent Bed	11.3 (8.4-14.8)	3.1 (2.0-4.6)	**< .001**
Infant seat	5.8 (3.8-8.5)	4.8 (3.4-6.6)	.502
Held	8.7 (6.2-11.8)	8.8 (6.9-11.1)	.935
Pram	8.2 (5.7-11.2)	12.7 (10.4-15.3)	**.024**
Other	13.6 (10.4-17.3)	11.4 (9.2-13.9)	.294
Night sleep location change (nights/week)			**< .001**
0 (never)	63.7 (58.8-68.4)	77.6 (74.4-80.6)	
1-3 nights	20.4 (16.6-24.6)	12.1 (9.9-14.7)	
4-6 nights	8.6 (6.1-11.7)	3.3 (2.1-4.8)	
7 (every night)	7.5 (5.0-10.2)	7.0 (5.3-9.0)	
Help to sleep			**.002**
Never	6.0 (4.0-8.8)	12.2 (9.9-14.7)	
Rarely	38.6 (33.8-43.5)	41.6 (38.0-45.3)	
Often	41.5 (36.6-46.5)	33.0 (29.6-36.6)	
Always	13.9 (10.7-17.7)	13.2 (10.8-15.8)	
Night waking (wakings/night)			.703
0	16.4 (13.0-20.4)	16.4 (13.8-19.3)	
1	46.5 (41.5-51.5)	45.9 (42.2-49.6)	
2	26.9 (22.6-31.5)	29.3 (26.1-32.8)	
≥3	10.2 (7.5-13.5)	8.4 (6.5-10.6)	
Night LSRSP			.227
< 2 hr	0.8 (0.2-2.1)	0.1 (0.0-0.7)	
2-4 hr	13.3 (10.2-17.0)	12.4 (10.1-15.0)	
> 4 hr	85.9 (82.2-89.1)	87.4 (84.8-89.7)	
Day LSRSP			**< .001**
< 1hr	5.7 (3.7-8.4)	11.3 (9.1-13.7)	
1-2 hr	26.6 (22.4-31.2)	35.0 (31.6-38.6)	
2-3 hr	34.5 (29.8-39.3)	34.5 (31.0-38.0)	
> 3 hr	33.2 (28.6-38.0)	19.2 (16.4-22.3)	
Reasonable mat. sleep (days/week)			.084
0 (never)	3.7 (2.1-5.9)	4.3 (3.0-6.0)	

	Māori	non-Māori	p
1-3 days	19.6 (15.8-23.8)	13.8 (11.4-16.5)	
4-6 days	45.2 (40.2-50.2)	46.2 (42.6-49.9)	
7 (always)	31.6 (27.1-36.4)	35.7 (32.2-39.3)	
Opportunity for mat. daytime breaks (days/week)			**.022**
0 (never)	2.9 (1.5-4.9)	7.0 (5.4-9.2)	
1-3 days	24.6 (20.5-29.1)	24.5 (21.5-27.8)	
4-6 days	33.0 (28.4-37.8)	33.7 (30.2-37.2)	
7 (always)	39.5 (34.7-44.5)	34.7 (31.2-38.2)	
Day-to-day change/Consistency			**.001**
Always the same	10.2 (7.5-13.5)	5.7 (4.2-7.6)	
Change occasionally	62.6 (57.6-67.3)	54.0 (50.3-57.7)	
Change often	18.8 (15.2-23.0)	29.3 (26.0-32.7)	
Every day is different	8.4 (5.9-11.5)	11.0 (8.8-13.5)	
Perceived problem, *n* (%)	18.0 (14.4-22.1)	26.1 (22.9-29.4)	**.003**

[a] Analysed with T-test, all others with Chi-square test
Abbreviations: LSRSP, longest self-regulated sleep period; Mat., maternal; NZDep, New Zealand Deprivation Index.

Mothers' Experiences of Infant Sleep

Most mothers reported their infants' sleep allowed them a reasonable amount of sleep on 4 or more days/week, which did not differ by ethnicity. However, non-Māori mothers were more likely to report their infants' daytime sleep patterns never allowed them to take a break (M 2.9% vs. nM 7.0%,). A large majority (> 90%) of mothers reported at least occasional day-to-day change in their infants' sleep patterns, though Māori mothers were more likely to report day-to-day consistency. Māori mothers were also more likely to report their infants "often" went to sleep with help from others and were less likely to rate their infants' sleep as problematic (M 18.0% vs. nM 26.1%).

Factors Associated with Infant Sleep Characteristics

Tables 5.2 and 5.3 present results from multivariable logistic models on the factors associated with infant sleep characteristics. After controlling for covariates, maternal ethnicity remained associated with infant sleep location. Ethnicity was not independently associated with key measures of infant sleep development, including night waking, nighttime LSRSP, night sleep location change, or the infant having help from others to go to sleep. Higher deprivation was

associated with higher odds of bedsharing and room-sharing, and lower odds of independent sleep, but was not associated with developmental markers of sleep.

Factors associated with increased odds of night waking were older maternal age, more maternal depression symptoms, exclusive breastfeeding, having returned to work, and bedsharing. Factors associated with shorter nighttime LSRSP were maternal depression symptoms, and bedsharing.

The relationship between sleep location and breastfeeding status appeared to change with changes to nighttime mother-infant proximity, with a positive association between bedsharing and breastfeeding (OR 1.82, $p = 0.012$), no association between room-sharing and breastfeeding, and a negative association between independent infant sleep and breastfeeding (OR 0.66, $p = .003$).

Table 7.2 *Socio-ecological factors associated with infant night sleep location and patterns*

	Bedsharing	Room-sharing	Independent sleep	Night wakings[a]	Night LSRSP < 4h	Night loc. change
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Mat. Ethnicity (Māori)	1.945 (1.186-3.190)**	1.591 (1.176-2.153)**	0.472 (0.336-0.662)***	1.004 (0.763-1.322)	0.943 (0.600-1.483)	1.386 (0.998-1.925)
Mat. Age	0.987 (0.946-1.030)	0.993 (0.968-1.018)	0.999 (0.972-1.026)	1.036 (1.013-1.060)**	1.007 (0.970-1.045)	0.99 (0.963-1.0170)
Infant Age	1.178 (1.025-1.355)*	0.937 (0.848-1.035)	1.025 (0.921-1.141)	0.988 (0.904-1.081)	0.962 (0.829-1.116)	1.031 (0.927-1.147)
NZDep (ref: Low, 0-3)						
Med (4-7)	1.721 (0.916-3.234)	1.136 (0.841-1.534)	0.927 (0.679-1.265)	0.904 (0.687-1.189)	0.839 (0.524-1.343)	0.890 (0.622-1.273)
High (8-10)	2.433 (1.255-4.715)**	1.719 (1.193-2.477)**	0.477 (0.318-0.715)***	1.243 (0.890-1.736)	1.105 (0.650-1.877)	1.099 (0.731-1.652)
Parity (Multip)	1.086 (0.679-1.736)	1.394 (1.070-1.815)*	0.691 (0.521-0.916)*	0.803 (0.632-1.019)	0.944 (0.632-1.410)	1.456 (1.077-1.969)*
EPDS	1.059 (1.008-1.112)*	0.995 (0.965-1.027)	0.968 (0.935-1.002)	1.053 (1.024-1.083)***	1.064 (1.019-1.111)**	1.011 (0.977-1.046)
Relationship (greater satisfaction)	0.850 (0.520-1.388)	0.637 (0.474-0.856)**	1.609 (1.162-2.228)**	1.024 (0.787-1.332)	0.966 (0.625-1.491)	0.715 (0.519-0.983)*
Life Stress	1.187 (0.727-1.937)	0.967 (0.729-1.283)	0.894 (0.66-1.211)	1.063 (0.823-1.374)	0.971 (0.633-1.491)	1.442 (1.051-1.978)*
Breastfed (excl.)	1.821 (1.141-2.906)*	1.143 (0.882-1.480)	0.659 (0.500-0.869)**	1.396 (1.102-1.768)**	1.106 (0.747-1.637)	0.832 (0.620-1.115)
Working	1.585 (0.821-3.062)	0.891 (0.578-1.375)	0.859 (0.532-1.387)	1.635 (1.096-2.438)*	1.107 (0.592-2.070)	1.800 (1.145-2.831)*
Bedsharing				3.562 (2.331-5.444)***	3.299 (1.956-5.562)***	2.383 (1.502-3.782)***

[a] Night Wakings analysed with ordinal logistic regression, all other others with binary logistic regression
Abbreviations: EDPS, Edinburgh Postnatal Depression Scale; excl., exclusive; LSRSP, longest self-regulated sleep period; Mat., maternal; multip, multiparous; NZDep, New Zealand Deprivation Index.
*$p < .05$, **$p < .01$, ***$p < .001$

Table 7.3: *Socio-ecological factors associated with infant day sleep location and patterns, and the maternal experience of infant sleep*

	Shorter daytime LSRSP[a]	Daytime mat. break	Reasonable mat. sleep	Help to sleep	Consistency
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Mat. Ethnicity (Māori)	0.588 (0.448-0.773)***	0.747 (0.536-1.040)	1.251 (0.862-1.817)	1.201 (0.892-1.617)	0.637 (0.463-0.876)**
Mat. Age	1.020 (0.998-1.042)	0.995 (0.969-1.022)	1.026 (0.995-1.059)	0.99 (0.966-1.015)	1.04 (1.013-1.067)**
Infant Age	1.061 (0.974-1.155)	0.944 (0.846-1.052)	0.990 (0.876-1.120)	0.959 (0.871-1.056)	0.945 (0.85-1.050)
NZDep (ref: Low, 0-3)					
Med (4-7)	1.020 (0.780-1.334)	0.907 (0.655-1.256)	0.769 (0.521-1.137)	1.050 (0.778-1.417)	1.011 (0.741-1.379)
High (8-10)	0.802 (0.580-1.108)	0.753 (0.506-1.121)	1.031 (0.660-1.611)	1.362 (0.951-1.952)	0.964 (0.661-1.406)
Parity (Multip)	0.585 (0.462-0.741)***	1.112 (0.836-1.480)	1.304 (0.933-1.824)	0.835 (0.643-1.083)	0.912 (0.695-1.199)
EPDS	1.032 (1.004-1.061)*	1.084 (1.049-1.120)***	1.117 (1.077-1.158)***	1.024 (0.993-1.056)	1.031 (0.998-1.064)
Relationship (greater satisfaction)	1.128 (0.869-1.464)	0.886 (0.648-1.210)	0.903 (0.633-1.289)	1.250 (0.935-1.671)	0.674 (0.498-0.910)*
Life Stress	1.240 (0.965-1.593)	1.027 (0.756-1.395)	1.115 (0.782-1.591)	1.254 (0.95-1.656)	1.055 (0.787-1.413)
Breastfed (excl.)	0.971 (0.773-1.220)	0.969 (0.733-1.281)	1.050 (0.757-1.456)	1.024 (0.794-1.322)	1.230 (0.941-1.608)
Working	1.141 (0.782-1.665)	0.826 (0.510-1.338)	1.142 (0.679-1.921)	1.193 (0.776-1.832)	0.769 (0.483-1.224)
Bedsharing	1.073 (0.709-1.623)	2.169 (1.369-3.435)**	1.396 (0.832-2.343)	1.807 (1.138-2.872)*	1.012 (0.629-1.627)

[a] Daytime LSRSP analysed with ordinal logistic regression, all other others with binary logistic regression
Abbreviations: EDPS, Edinburgh Postnatal Depression Scale; excl., exclusive; LSRSP, longest self-regulated sleep period; Mat., maternal; multip, multiparous; NZDep, New Zealand Deprivation Index
*$p < .05$, **$p < .01$, ***$p < .001$

Characterising Perceived Sleep Problems

As presented in Table 5.4, factors associated with decreased odds of a perceived sleep problem were multiparity, greater relationship satisfaction, higher life stress, being in paid employment, and bedsharing. Conversely, factors associated with increased odds of perceived problematic sleep included more maternal depression symptoms and fewer maternal opportunities for sleep and rest.

There was a dose-response relationship between night waking and perceived problem sleep; compared to mothers whose infants did not wake between 10pm and 6am, mothers whose infants woke once were no more likely to rate their infant's sleep as problematic, while mothers whose infants woke twice had approximately 2x increased odds, and those whose infants woke three or more times had more than 4.5x increased odds. Daytime LSRSP < 1 hr was associated with a perceived sleep problem, but night LSRSP was not.

Neither maternal sleep duration nor quality were associated with a perceived infant sleep problem, however measures that aimed to capture the maternal experience of infant sleep (*Fewer maternal opportunities for daytime breaks;* infant receives *help to sleep; day to day change* in infant sleep patterns*)* were each associated with more than 2x increased odds of a perceived sleep problem.

Table 7.4: *Infant sleep and socio-ecological factors associated with perceived infant sleep problem*

	p	OR (95% CI)
Maternal ethnicity (Māori)	.538	0.873 (0.566-1.345)
Maternal age	.398	1.016 (0.980-1.053)
Infant age	.287	0.917 (0.782-1.076)
NZDep *(ref: Low, 0-3)*		
Med (4-7)	.676	0.915 (0.605-1.386)
High (8-10)	.218	0.723 (0.431-1.212)
Parity (Multip)	**<.001**	**0.461 (0.314-0.677)**
EPDS	**.001**	**1.077 (1.030-1.126)**
Relationship (greater satisfaction)	**.015**	**0.599 (0.397-0.904)**
Life stress	**.019**	**0.615 (0.410-0.922)**
Breastfed (excl.)	.381	0.850 (0.591-1.222)
Working	**.012**	**0.419 (0.213-0.824)**
Bedsharing	**.010**	**0.420 (0.217-0.812)**
Maternal sleep duration	.853	0.987 (0.856-1.137)
Maternal sleep quality	.305	1.082 (0.931-1.257)
Night wakings *(ref: 0 Wakings)*		
1 waking	.968	0.988 (0.538-1.815)
2 wakings	**.029**	**2.067 (1.078-3.965)**
≥ 3 wakings	**.001**	**4.460 (1.894-10.503)**
Night LSRSP ≤ 4 hr	.470	0.807 (0.450-1.445)
Night sleep location change	.599	1.116 (0.742-1.679)
Day LSRSP *(ref: > 3 hr)*		
2-3 hr	.760	0.920 (0.538-1.572)
1-2 hr	.165	1.450 (0.858-2.450)
< 1 hr	**.045**	**1.986 (1.015-3.884)**
Daytime break opportunities (< half the week)	**<.001**	**2.640 (1.806-3.860)**
Reasonable maternal sleep (< half the week)	**.001**	**2.226 (1.414-3.505)**
Infant has help to sleep (often/always)	**<.001**	**2.290 (1.581-3.315)**
Day to day change (always/frequent)	**<.001**	**2.477 (1.725-3.557)**

Note: Bold text highlights statistically significant associations, as indicated by the *p*-values.
Abbreviations: EDPS, Edinburgh Postnatal Depression Scale; excl., exclusive; LSRSP, longest self-regulated sleep period; Mat., maternal; multip, multiparous; NZDep, New Zealand Deprivation Index

Discussion

This study described and compared the sleep of infants of Māori and non-Māori NZ mothers at approximately 12 weeks of age. It also drew on socio-ecological models of sleep health to explore factors associated with different sleep locations and patterns and characterized maternal perceived infant sleep problems at this young age. Consistent with established literature, we found sleep at 12-weeks to be highly variable (Galland et al., 2012; Jenni & Carskadon, 2012). The infants of Māori and non-Māori mothers differed somewhat in *where* but less in *how* they were sleeping. A variety of factors were associated with perceived problems, and these did not always align with commonly accepted markers of sleep development.

A review of normal sleep patterns in infants and children found infants woke on average 0.8 times per night at 3-6 months and exhibited a mean longest sleep period of 5.7 hr at 0-5 months, though data varied widely – particularly for night waking (Galland et al., 2012). Broadly in line with this, our findings showed almost half of Māori and non-Māori mothers reported one night waking, more than one quarter reported two wakings, and approximately 9% reported their infants woke three or more times, while approximately 16% reported their infants slept through the night. More than 85% of both groups reported night LSRSPs longer than 4 hours. We found no evidence of ethnic inequities in key developmental aspects of sleep at 12 weeks; night waking and night LSRSP. These findings add to prior research to suggest sleep health inequities emerge somewhere between 3 months and 3 years as a result of exposure to ethnic inequities in social determinants of health (Galland et al., 2012; Paine & Muller, 2023).

According to both the American Academy of Paediatrics and the NZ Ministry of Health, room-sharing on a separate, flat sleep surface is recommended as the safest sleep location for infants under 6 months, to avoid sleep-related infant deaths (Ministry of Health, 2022; Moon et al., 2022). Māori mothers were more likely to report room-sharing, in line with recommendations. Both groups also reported sleep practices inconsistent with recommendations; Māori mothers were

more likely to report bedsharing, and non-Māori mothers were more likely to report their infants slept independently, in their own bedrooms. These findings were broadly consistent with prior work on infant sleep practices in NZ (Scragg et al., 1996; Tipene-Leach et al., 2010). This study was novel in the level of detail it provided on day sleep location and patterns at 12 weeks, which were found to be particularly variable.

Our rates of room-sharing are ostensibly positive, and yet should be considered in light of a range of potential drivers. In addition to higher rates of room-sharing among Māori, room-sharing was more common among dyads in the high deprivation category. Research indicates people who live in more deprived areas are more likely to live in overcrowded, underheated homes; factors that might contribute to both room- and bedsharing rates (Tipene-Leach & Fidow, 2022; Wennergren et al., 2021; Wilson et al., 2014). It is well known that Māori are over-represented in the most deprived neighbourhoods of NZ, and so our findings may reflect, at least in part, the inequitable distribution of SEP by ethnicity. Marginalized groups have fewer structural opportunities for sleep-supporting practices (Muller, Paine, et al., 2022; Reid et al., 2019), and the recommended practice of room-sharing may not always confer the intended safety benefits in this context. For example, one study found room-sharing was associated both with lower SEP, and higher rates of overnight transitions to bedsharing, against recommendations (Paul et al., 2017). Conversely, other studies report no relationship between SEP and sleep location, and find bedsharing to be an increasingly common practice returning to Western culture, largely to facilitate the recommended practice of breastfeeding (Blair & Ball, 2004; Wennergren et al., 2021). Together, these findings highlight the need for nuanced explorations of infant sleep practices in future research (Blair & Ball, 2004; Paul et al., 2017; Wennergren et al., 2021). Findings from such work could help to address structural barriers to safe sleep while supporting families to navigate their unique sleep preferences alongside risk-reduction recommendations and available resources.

Consistent with current literature, mother-infant proximity at nighttime was also associated with breastfeeding (Baddock et al., 2019; Blair & Ball, 2004; Wennergren et al., 2021). We found

bedsharing infants had increased odds of breastfeeding and, conversely, independent sleeping infants had decreased odds. Also in line with socio-ecological models, maternal depressive symptoms were associated with more night waking, shorter night- and day LSRSP, and fewer opportunities for reasonable maternal sleep. Directionality cannot be determined in this cross-sectional study, but research suggests the relationship between maternal depression and infant sleep is bi-directional (Sadeh et al., 2010).

We found a dose-response relationship between night waking and a perceived infant sleep problem, underscoring the salience of night waking in parents' perceptions of infant sleep (Henderson et al., 2013; Mindell et al., 2022; Sadeh et al., 2011). One waking (versus none) showed no effect, suggesting some night waking is expected in early infancy (Ball, 2013; Barry, 2021a). Conversely, two wakings was associated with a two-fold increase in a perceived problem, and three plus with a more than four-fold increase. These results are striking given we found that at 12 weeks, infants are more likely to wake twice than not at all. They point to a tension between what is normative for infants and what is expected and/or manageable for caregivers. Eagerness among mothers to ease this tension is evident in participant feedback from intervention studies aimed at supporting sleep in early infancy (Ball et al., 2018; Sweeney et al., 2020). In addition to night waking, the association between a perceived sleep problem and infants receiving more help settling to sleep is consistent with prior research (Bayer et al., 2007; Loutzenhiser et al., 2011). Contrary to established findings (Henderson et al., 2013; Mindell et al., 2022; Sadeh et al., 2011), night LSRSP was not associated with a perceived problem in the current study, perhaps due to a ceiling effect in our LSRSP variable.

Our study highlights the pertinence of day sleep, with short daytime LSRSP, more day-to-day change in sleep patterns, and fewer opportunities for daytime breaks all associated with a perceived sleep problem. This aligns with research that indicates issues with napping is the most frequently reported sleep concern by caregivers of infants (Mindell et al., 2022). Our somewhat surprising finding that mothers who had returned to work were less likely to perceive a sleep

problem might be explained by a reduced sensitivity to nap difficulties in this group. Consistent with this idea, one study showed that while mothers reported similar levels of stress regardless of work status, stress levels were more tightly linked to infant sleep disturbances among mothers on parental leave, compared to those working outside the home (Sinai & Tikotzky, 2012).

Research suggests infant sleep patterns that cause more parental sleep disturbance are more likely to be perceived as problematic, particularly in Western culture (Mindell et al., 2015). We found an association between a perceived problem and mothers' subjective judgements of whether their infants' sleep patterns afforded mothers reasonable sleep, but not with self-reported maternal sleep duration, nor quality. Individual differences in sleep needs and adaptability may affect how mothers experience infant-related sleep disturbances (Dongen et al., 2004; Fjell & Walhovd, 2024).

Several socio-ecological variables were associated with a perceived infant sleep problem, including maternal depression symptoms, life stress, and relationship satisfaction. These findings support a recently proposed model by D'Souza and Cassels (2023) that emphasizes the role of contextual factors in parents' perceptions of their children's sleep. Similar to other findings (Loutzenhiser et al., 2011), bedsharing was not associated with a perceived sleep problem, despite its association with common Western indices of poorer sleep development (Henderson et al., 2013; Mindell et al., 2022; Sadeh et al., 2011). Some authors suggest that mothers who choose to bedshare might have more realistic expectations of infant sleep (Ball, 2013; Barry, 2021a; D'Souza & Cassels, 2023). Others offer culture-based explanations; Latz et al. (1999) found bedsharing was associated with sleep problems among American but not Japanese infants. Alternatively, in the context of high deprivation, infant sleep might be evaluated less negatively relative to concurrent challenges (Barry & McKenna, 2022). Indeed, we found high life stress was associated with decreased odds of a perceived sleep problem. Reasons for bedsharing were not assessed in the current study, and these tentative interpretations require empirical investigation.

Our findings have important clinical and public health implications. Large intra- and inter-infant variability in sleep patterns is expected in early infancy, and parents should be supported to anticipate and manage the significant challenge this brings. Support should include the provision of perinatal services that are fit for purpose. Research indicates fear of judgement from health providers prevents many mothers from disclosing their sleep practices and concerns (Clapham et al., 2024). This leads to the provision of insufficient or unsuitable care that ultimately perpetuates perceived problems and maternal distress (Clapham et al., 2024). It is critical that services are open and responsive to families' unique needs.

A key strength of this study lies in the Kaupapa Māori methodological approach of *Moe Kura* (Signal et al., 2022), which provided a sample broadly representative of the NZ mother-infant population with sufficient analytical power to explore Māori/non-Māori differences. Another strength was its inclusion of detailed day sleep data. Where most studies have focused primarily on night sleep, our findings indicate day sleep is more variable than night sleep and highly relevant to maternal perceptions of infant sleep. Finally, our study provides a strong basis for future research. The misalignment of normative sleep patterns with the characteristics of perceived problems requires further exploration. The relationship between maternal depression and child sleep also warrants further research. We found symptoms of maternal depression were associated with multiple domains of infant sleep, and perceived sleep problems. Elucidating potential mechanisms of transmission might point to interventions that can benefit maternal mental health and child sleep.

Study limitations include the cross-sectional design, which precludes causal inference, and the exclusive reliance on maternal self-reports during a challenging life stage. However, since parental experiences of infant sleep often drive presentations to health services, our measures had good ecological validity. A related limitation is our exclusive focus on maternal experiences. This fits with the broader aims of the *Moe Kura* study but means our findings cannot be generalized to other caregiver-infant dyads. There were also limitations to some measures. Our

sleep-surface multichoice options did not include wahakura (Indigenous flax basket) or Pēpi Pod (plastic bassinet); two in-bed, bassinet-like sleep devices often used in NZ, particularly among Māori (Tipene-Leach & Fidow, 2022). Bedsharing rates might have been overestimated if mothers selected the "parent-bed" option for wahakura or Pēpi Pod bassinets. However, it is reassuring that our bedsharing rates align with other NZ research (Galland et al., 2014). We did not assess reasons for bedsharing, which appear highly relevant to parental perceptions of infant sleep (D'Souza et al., 2023). We also had no suitable measure of infant temperament, so could not account for this aspect of infant regulation. Some studies have found infant temperament is related to infant sleep (Sorondo & Reeb-Sutherland, 2015), while others have not (Martini et al., 2017). Our measure of night LSRSP prevented analysis of LSRSP beyond the maximum response option of > 4 hr; including longer durations might have revealed more and/or stronger associations (Galland et al., 2012).

Conclusion

In line with prior research, we found infant sleep at ~12 weeks of age to be highly variable, particularly during the day. Infants of Māori and non-Māori mothers differed somewhat in *where* but less in *how* they were sleeping. No ethnic differences were found in key measures of sleep development: night waking and night LSRSP, indicating sleep-health inequities evident in prior research emerge somewhere between 3 months and 3 years, likely resulting from exposure to ethnic inequities in social determinants of health. Māori mothers were more likely to room- or bedshare with their infants, and the infants of non-Māori mothers were more likely to sleep independently. This study drew on socio-ecological models of infant sleep and found several factors were related to different dimensions of infant sleep at ~12 weeks, and to maternal perceptions of an infant sleep problem. It finds several important associations that provide a strong basis for future research.

Clinical Internship Reflections

On the surface, my clinical internship had very little to do with my thesis research. Clinically, I worked primarily with teens with Type 1 Diabetes (T1D), whereas my research explored the relationships between maternal mental health and sleep in infants and pre-schoolers. I was initially concerned about how I would draw connections between these apparently disparate areas for the purpose of this case study. I needn't have worried; as emphasised by established models of sleep health (Buysse, 2014; Meltzer et al., 2021), sleep health is multidimensional, and each dimension has specific implications for boarder health outcomes. It follows then that sleep health is relevant to the management of diabetes.

Research suggests that adequate and good quality sleep contributes to the maintenance of optimal glycaemic control, measured by glycated haemoglobin (HbA1c), in children and adolescents (Turner et al., 2016). These associations are likely due to the impact of sleep on behaviours that drive adherence to diabetes management plans (Perez et al., 2018). In addition to sleep duration and quality and, sleep variability also appears to be important. Inconsistent sleep patterns have been associated with poorer glycaemic control (Chontong et al., 2016). Beyond the medical management, good sleep health is central to the psychological wellbeing in individuals with diabetes. As in the general population, sleep disturbances are associated with emotional, behavioural, and cognitive problems in people with T1D (Perez et al., 2018), and there are clear relationships between sleep and academic outcomes among youth with T1D, including school absences and performance in reading, maths and writing (Perfect, 2014).

Sleep is an important feature of all psychological assessments, but it has additional, specific implications that must be considered in the assessment and treatment of individuals with T1D. Further my understanding of these associations over the course of my thesis has prompted me to keep sleep top of mind with my clients. None of my internship clients to date have presented with sleep as their primary concern or treatment priority. Nevertheless, sleep is an important

component of any initial psychological assessment. In T1D, as in most populations, sleep often constitutes an important perpetuating factor and I have found that even brief psychoeducation on sleep and its relationship to diabetes management and mental health is beneficial to clients.

Another link between my thesis and clinical work pertains to equity. Inequity is caused by pernicious, systemic issues that, by definition, affect all aspects of people's lives (Reid et al., 2017). Paper 1 of my thesis (included above) investigated potential inequities in the sleep health of 12-week-old infants of Māori and non-Māori mothers. We found no differences in the sleep characteristics of these infants, yet we know they exist by age 3 years (Muller et al., 2022) and appear to persist into adulthood (Paine et al., 2016). This pattern of emergence suggests the sleep health inequities are a consequence of institutional racism which produces and maintains systemic inequities in the social determinants of health.

There are myriad ways these forces conspire to disadvantage Māori health. In T1D, one important source of inequity that affects both diabetes management and sleep health is in access to continuous glucose monitors (CGMs), an alternative to self-monitoring of blood glucose (SMBG), usually by finger prick blood test. The benefits of CGM for diabetes care are well established. Numerous randomised controlled trials have shown CGMs improve glycaemic control, particularly with increased time in range (TIR) and reduced time below range (TBR), i.e., hypoglycaemia (low blood glucose; (Elbalshy et al., 2022). Severe hypoglycaemia is life threatening; it can lead to seizures, unconsciousness, and death if not promptly treated. It can occur at night when individuals are sleeping and therefore not conscious of early signs of declining blood sugar. Without CGMs, fear of undetected overnight hypoglycaemia can cause significant sleep disturbance for young people with T1D and their caregivers. Many diabetics and/or their caregivers will wake several times each night to manually check BGLs. In the first paediatric diabetes clinic I shadowed, I met a father and son who had recently moved from SMBG to CGM. The father reported his son's CGM afforded the family their first nights of undisturbed sleep since the child was diagnosed some 6 years prior. The clinician informed me this is a

common story. Many parents of young children sleep on the floor in their child's room to ensure they can easily check and respond to overnight hypoglycaemia. Not surprisingly, sleep anxiety is common among people with T1D, and those who care for them.

The CGM is part of gold standard T1D care; something to which The National Institute of Health and Care Excellence (NICE) guidelines state all children with T1D should have access. Yet, CGMs at the time of writing (October 2023) CGMs are not funded in New Zealand. They cost approximately $200/month, a prohibitive cost for many New Zealand families. Systemic racism has produced socioeconomic inequities that mean Māori and Pacifica families are more likely to go without CGMs than other groups, and yet, research shows Māori have the most to gain from CGMs. Burnside et al. (2023) found that when children moved to CGM from SMBG, Māori children had the greatest reduction in HbA1c, compared to European, Pacific and Asian children. In July 2023 Pharmac announced a request for proposals (RFP) to fund CGMs for people with T1D, acknowledging that "for many of the 17,000 New Zealanders living with T1D, having funded access to these devices would be life changing" (Pharmac, n.d.); not least for the benefits to individual and whānau sleep health.

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