Breastfeeding practices in New Zealand during the first year postpartum

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Abstract

There is a lack of research observing breastfeeding (BF) practices in detail globally and in New Zealand (NZ). This longitudinal study examined BF patterns and the association between BF duration and frequency per day in NZ infants from the birth to 12 months old. A total of 61 self-selected women in the Manawatu region were recruited during the last stage of pregnancy. The average age was 32.1±0.6 years.

BF practices were obtained by 24-hour recall noting all of the infant's activities through a telephone interview. The interviews were conducted at approximately 2 weeks after birth and then at 2 weekly intervals during the first three months, and then once per month until the infants first birthday.

Results show that the majority of infants during the first four weeks postpartum were fully BF (81% at two weeks & 82% at four weeks), 8% infants were mixed-fed and 10% had stopped BF by four weeks. At 16 weeks, 61% infants were fully BF, and 9% infants had been introduced to complementary foods (CF). At 24 weeks, most infants (93%) were no longer fully BF and 24% were receiving no breastmilk. At 48 weeks, 48% infants had stopped BF.

Regarding BF patterns, throughout the first 48 weeks postpartum there was a wide variation of BF frequency/day, the longest interval between BF and the length of BF sessions. For example, at two weeks fully BF infants were fed from 5-21 times/day (interquartile range (IQR): 8-10 times/day); at 48 weeks BF infants receiving CF had from 1-22 breastfeeds/day (IQR: 3-8.3 times/day). For the longest interval between BF, at two weeks for fully BF infants the longest interval ranged from 3-10 hours (IQR:4.3-5.5 hours), and at 48 weeks for BF infants receiving CF the longest interval

ranged from 3-24 hours (IQR:6.4-12.5 hours). The length of BF session, at two weeks ranged from 2-205 minutes/feed (IQR: 12-30 minutes) for fully BF infants, and at 48 weeks ranged from 4-85 minutes/feed (IQR: 5-15 minutes) for BF infants receiving CF.

At the majority of observations there was a significantly lower BF frequency/day and longer longest interval between breastfeeds for mixed-fed infants compared to infants who were fully BF ($p<0.05$). For instance, at four weeks, median BF frequency/day for mixed-fed infants was five times/day, and for fully breastfed infants ten times/day; at 16 weeks the median BF frequency, for mixed-fed infants was 6.5 times/day, and for fully breastfed infants 9.5 times. At four weeks, the median of the longest interval between breastfeeds for mixed-fed infants was 8.5 hours, and for fully breastfed infants five hours; at 16 weeks, for mixed-fed infants the median was 11.8 hours, and for fully breastfed infants 6.2 hours. There was generally no significant difference in the length of BF sessions between these two groups ($p>0.05$).

There was a significantly positive, but weak correlation between BF duration and BF frequency/day at two weeks ($p<0.01$; $r=0.352$) and four weeks ($p<0.01$; $r=0.404$), and between BF duration and BF frequency/day of fully BF infants at four weeks ($p<0.05$; $r=0.289$). There was no significant correlation between duration of BF/fully BF and maternal and infant characteristics, with the exception of parity (there was a positive association between parity of two or more and BF duration, $p<0.05$).

Case studies were made of four participants who were still breastfeeding their babies at 48 weeks and whose frequency of feeding in the first four weeks after birth was

outside of the often recommended 8-12 times/day. Results show that their BF practices varied widely between women during 48 weeks. BF frequency and the total length of BF sessions decreased over time. For two infants who had higher BF frequency in the first four weeks, BF frequency remained relatively high through the end of the first year. For another two infants who had lower BF frequency in the first four weeks, BF frequency remained relatively low through the end of the first year. For all cases, the total length of BF sessions per day did not generally fluctuate with the changes of BF frequency.

In conclusion, this longitudinal study supplies a detailed picture of BF practices by 24-hour recall. Results show that almost half infants had stopped BF by 48 weeks. There is a wide variation of BF practices associated with successful BF. Therefore, individuals' particularity should be considered when making suggestions to the mother. Overall, this thesis may contribute to the literature on BF practices in NZ.

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List of Abbreviations

BF	Breastfeeding
BFCI	The Baby Friendly Community Initiative
BFHI	The Baby Friendly Hospital Initiative
CF	Complementary foods
IQR	Interquartile range
NZ	New Zealand
NZBA	The New Zealand Breastfeeding Authority
WHO	World Health Organization

Chapter One Introduction

1.1 Background of the study

Breastmilk is the primary food to support infant growth and development. In New Zealand (NZ), breastfeeding (BF) was the social norm but started to change by the middle 1800s, after which time bottle feeding became fashionable. This was accompanied with an upsurge of commercial manufacturer of infant formula. Urban and middle class families especially perceived bottle feeding to be a comfortable lifestyle — easy, time-saving and convenient (National Breastfeeding Campaign, 2010). Recently, the benefits of BF have been widely documented and BF has been advocated (Ministry of Health, 2008).

BF not only just supplies an ideal food for the infant, but is also a safeguard against many diseases for mothers (psychological depression, possibly reducing ovarian and breast cancer), and for infants (immunological diseases including ear, gastrointestinal and respiratory infections, food allergen, sudden infant death syndrome). It may also have a far-reaching influence on infants' health status in later life (Fisher, 2010).

The NZ Ministry of Health has set improving the duration of exclusive/full BF and BF as a target to be achieved (Ministry of Health, 2007 & 2008a). Therefore, they have made many efforts to promote BF. Two national programs regarding BF — the Baby Friendly Hospital Initiative (BFHI) and the Baby Friendly Community Initiative (BFCI) were launched by the NZ Ministry of Health (Ministry of Health, 2002). Almost all maternity services have obtained Baby Friendly Hospital

accreditation (Fisher, 2010). The New Zealand Breastfeeding Authority (NZBA) is a non-profit organization which was created in 1997-8, and its primary purpose is to promote BF in NZ through support and development of the BFHI and the BFCI in NZ (Ministry of Health, 2002 & 2009). BF is also supported by the Plunket Society and La Leche League. There are other supporting groups and campaigns such as World Breastfeeding Week held every year during the first week of August (Ministry of Health, 2002).

In NZ, the rate of BF initiation is high by international standards, but the rate of exclusive/full BF till six months and BF till 12 months has not reached the target set by the NZ Ministry of Health in 2002. Therefore, extending the duration of BF and full/exclusive BF is a mission of the NZ government (Ministry of Health, 2009). There have been many studies identifying influential factors on BF practices. However, there have been few studies examining BF patterns. Only four published studies have specifically observed detailed BF practices in developed countries: Salariya and other researchers in UK (1978), Hörnell and colleagues in Sweden (1999 & 2001), and Shealy and co-workers in US (2008).

In order to understand BF problems and difficulties, and supply practical information to develop appropriate strategies for promoting BF, it is necessary to observe BF practices. This study is going to describe BF practices of NZ mother infant pairs through the first year after birth.

Chapter Two Literature Review

2.1 The context of breastfeeding

2.1.1 Beneficial effects of breastfeeding

2.1.1.1 Specificity of human milk

The protein in human milk is different from that in cow's milk, which is the major source of protein in most infant formula (Le Huerou-Luron et al., 2010). Formula has higher protein content and higher ratio of casein to whey than human milk (El-Agamy, 2007). In breastmilk the ratio of whey to casein is about 80:20 or 90:10 during the first few days after the birth, to 60:40 during the period of established lactation (about 2-3 months), and 50:50 during the later term of lactation (Le Huerou-Luron et al., 2010; Darragh & Lönnerdal, 2011). Moreover, the lactose and lipids have a lower concentration in the early breastmilk, compared to that in infant formula. All these components of the breastmilk can make it easier for the infant to digest and more effectively utilise the nutrients, and are beneficial to the development of the infant's digestive tract, compared to infant formula (Le Huerou-Luron et al., 2010).

The non-nutritional components in human milk include growth factors, nucleotides, immunologic components, maternal antibodies, hormones, enzymes and cytokines; these may not only modulate and support organs development (especially the digestive system), and accelerate the infant's own defence system maturity, but may also have a protective effect against many illnesses (particularly against infectious illnesses) (Weaver, 1997; Le Huerou-Luron et al., 2010; Moreno-Villares &

Galiano-Segovia, 2013). Compared to breastfed babies, formula fed babies have more health problems (National Breastfeeding Advisory Committee, 2009).

2.1.1.2 Benefits to infants of breastfeeding

In NZ, promoting BF is one of the strategies to achieve the national health goals to improve nutrition and reduce obesity and other diseases, including cardiovascular disease, diabetes and cancers (Ministry of Health, 2002 & 2008). Specific to the infant, BF not only supplies the best food for them, but also has many health benefits. Breastmilk is easily digested, and supplies enough energy and all nutrients requirements for infants during the first six months after the birth (Campbell, 1996; Moreno-Villares & Galiano-Segovia, 2013). It promotes the development of organs and defence systems, and also protects against many diseases (gastroenteritis, infections of respiratory tract and urinary tract, and other viral and bacterial illnesses) (Amir & Livingstone, 2010; Le Huerou-Luron et al., 2010), and help to decrease infant hospitalisation and mortality (Campbell, 1996; Bachrach et al., 2003; Ministry of Health, 2008).

These health benefits have been acknowledged in western society (Bachrach et al., 2003; Ministry of Health, 2008). In NZ, not breastfeeding was reported to be one of risk factors for sudden infant death syndrome (Davidson-Rada et al., 1995; Mitchell et al., 1994 & 1997 & 2001). Not exclusively BF during the first six months may increase the incidence and severity of acute lower respiratory tract infections, and even result in death from such illness (Grant et al., 2011). Some other health benefits of BF still require more research including the roles in preventing

cardiovascular diseases, diabetes (WHO, 2007 & 2013; Chung et al., 2007) and overweight/obesity (WHO, 2007; Chung et al., 2007; Cope & Allison, 2008).

2.1.1.3 Benefits to mothers of breastfeeding

BF has benefits for the mother as well. It may help women to lose body weight gained during pregnancy (Campbell, 1996; Moreno-Villares & Galiano-Segovia, 2013), to build a close relationship with their babies (Jansen et al., 2008), to prevent pregnancy (Campbell, 1996; Lawrence, 2000), and to prevent postpartum depression (Lawrence, 2000; Chung et al., 2007; Moreno-Villares & Galiano-Segovia, 2013). BF is associated with decreased risk of some cancers (Bartick, 2013; Salone et al., 2013), such as breast cancer (Do Carmo França-Botelho, 2012) and ovarian cancer (Jordan, 2012; Feng et al., 2014). More research is needed to reach conclusions about the relationship of BF to type 2 diabetes and cardiovascular disease (Kelishadi & Farajian, 2014, Chung et al., 2007).

2.1.1.4 Social benefits of breastfeeding

Breastmilk is environmentally friendly — leaves no waste and does not require heating or sterilising of equipment. It has been well documented that BF has an economic contribution, owing to its cost-effectiveness (Amir & Livingstone, 2010). It greatly reduces family expenditure (not need to buy formula) and health care costs by enhancing infant and maternal health and protecting against diseases (Smith et al., 2002; Amir & Livingstone, 2010).

Hospital costs towards infants illnesses related to early cessation of BF (gastrointestinal, respiratory disease, otitis media, necrotising enterocolitis and eczema) in the Australian Capital Territory were estimated to be about $1-2 million per year (Smith et al., 2002). A 2007 a US report by the Agency for Healthcare Research and Quality stated that suboptimal BF rates lead to excessive social costs and infant deaths. It estimated that if 90% infants could follow the WHO recommendation — six months of exclusively BF, the United States would save $13 billion a year and save approximate 900 lives. This included both indirect and direct expenses of all paediatric illnesses which may be protected against by BF, and the expenses of premature death (Bartick & Reinhold, 2010). These studies advocated that improving exclusive BF duration would be an important approach to save costs and benefit the society. In NZ, the Ministry of Health states that BF can save public money as well (Ministry of Health, 2007; Fisher, 2010). If 50% infants are exclusively BF to six months, hospital costs for treating infants aged under 12 months would be reduced about $12.7 million per year (Fisher, 2010).

2.1.2 Breastfeeding rate in New Zealand

According to data reported by the Plunket Society (2010), there has been a significant increase in the rate of BF in NZ during the last 30 years. Data recorded during the first Plunket visit between 2-6 weeks of age show rate for any BF increased from the low around 48% in 1968-1969 to around 84% in 2010. In the last ten years of this report period, the rate for any BF has shown no noticeable change or improvement, remaining at about 80%.

Through many efforts to encourage BF, a high BF initiation rate of 94% has been achieved in NZ. The challenge is to improve the BF rate at six weeks, 12 weeks, 24 weeks and beyond (Ministry of Health, 2009). The exclusive and full BF rate decreased greatly after the first 6 weeks and has not met targets set by the Ministry of Health in 2002. Specifically, in 2009, the exclusive and full BF rate was about 65% for 2-5 weeks, and decreased to about 55% for 10-15 weeks, and then continued to drop to about 26% for the period between 16 weeks to seven months (Plunket Society, 2010). According to the Growing Up in NZ (2012), median age of stopping exclusive BF was 3.85 months, and 94% of mothers stopped exclusive BF by 24 weeks. The BF rate varies between ethnic groups in NZ. Generally, Maori, Pacific and Asian have a lower BF rate than the rest of the NZ population (Plunket Society, 2010).

Facing a low prevalence of BF, NZ is not alone. Actually, it is also a key challenge worldwide. According to a recent review paper, more than half the infants under four months throughout the world are not exclusively breastfed and even fewer are exclusively breastfed for the optimum six months, although differences exist between areas (Moreno-Villares & Galiano-Segovia, et al., 2013). Specifically, Southeast Asia had the highest rate of exclusive BF compared to other regions. The European country Spain had 52.5% and 24.7% infants who were exclusively breastfed for about four and six months, respectively, and Sweden had 56.2% and 12.3% infants. UK had less than 1% infants exclusively breastfed for six months, and Norway had only 9%. Australia had a relatively higher percent of exclusively breastfed infants of about 19% to six months (Moreno- Villares & Galiano-Segovia, 2013).

2.1.3 BF recommendations

The World Health Organization (WHO) recommends six months of exclusive BF, and then introduction of complementary foods (CF) and continuation of BF up to two years or beyond (WHO, 2002).

The NZ Ministry of Health recommends exclusive BF duration of around six months, and then introduction of appropriate CF and continuing BF up to one year or beyond (Ministry of Health, 2011).

The WHO BF recommendation is a global health target, aimed at decreasing infant morbidity and mortality. For infants in developed countries, exclusive BF for 6 months seems to have no adverse effect on infants' health and development. Conversely, six months BF has health benefits, compared to earlier introduction of CF (WHO 2002; Kramer & Kakuma, 2012). From around six months, breastmilk alone does not provide enough energy and nutrients for infant development. Hence, other foods are needed to complement breastmilk to provide additional nutrients for growth and development. WHO recommends that BF should last for at least 2 years, since its continuation may make a positive contribution to overall health, even in adult life (WHO & UNICEF, 2009).

The NZ recommendation is slightly different from the WHO recommendation. NZ recommends BF for at least a year, rather than 2 years. This is because it was felt that 2 years may be an unrealistic target, particularly for Maori and Pacific Island women, whose BF statistics lag behind NZ European women (Ministry of Health, 2008b). NZ mothers commonly give CF to infants too early (between 4-6 months), and therefore the NZ government has made efforts to try to increase

the age of introducing complementary foods and prolong exclusive BF duration (Ministry of Health, 2008).

2.2 Factors affecting breastfeeding duration

There are a number of factors which have been shown to affect BF duration in Western Countries, including NZ. A review article by Thulier and Mercer (2009), classified factors into four categories: biological factors, which include insufficient milk supply, delivery methods, maternal and infant physical problems, maternal obesity, smoking and parity; social factors such as social and family support, maternal employment; psychological factors such as maternal confidence and intention, depression and stress; and demographic factors such as maternal education, age and race, marital situation, and family income. The following review will be structured based on these categories.

2.2.1 Biological factors

Insufficient milk supply is consistently documented in the literature as a primary reason for women worldwide introducing artificial milk and stopping BF (Henly et al., 1995; Thulier & Mercer, 2009). Some NZ studies have also found that insufficient milk supply is one of top risk factors associated with shorter duration of exclusive BF, and any BF (Essex et al., 1995; Heath et al., 2002; Butler et al., 2002 & 2004).

The Growing Up in NZ study observed that 52% women (total No. =6234 from three regions: Auckland, Counties-Manukau and Waikato) stopped BF by nine months. This was attributed to many factors including returning to work, babies unsatisfied by only feeding breastmilk (i.e. mothers' perception that the baby was still hungry), and babies weaning themselves, but the major reason was insufficient breastmilk (Morton et al., 2012). A NZ cohort study that focused on the Pacific population found that reporting of insufficient milk supply was high, but varied among women with different feeding approaches ─ it was reported by 21% of women who were exclusive BF, by over 50% of women who were mixed feeding (breast and formula), and 53% reporting from women exclusively formula feeding (Butler et al., 2002). When considering reasons for insufficient milk supply, it is important to note that there may be several maternal factors affecting it, some physical (fatigue, sleep disturbances, and breast pain) and some psychological (stress, less intention and confidence). However, it is estimated that only 5% women are physically unable to produce enough breastmilk, due to biological factors such as damaged duct and neurological system, or the inappropriate concentration of hormones (prolactin, oxytocin and oestrogen) (Thulier & Mercer, 2009; Kent et al., 2012), and deficient glandular tissue (Neifert et al., 1985; Kent et al., 2012). How BF is practiced and managed will influence milk supply, and will be discussed in section three.

Perceived insufficient milk supply may result in actual secondary insufficient milk supply, since perceived insufficient milk may lead to ineffective milk removal (e.g. by introduction of 'top up' formula) which will reduce milk supply (Fraser & Cullen, 2009). Perceived insufficient milk supply is thought to occur more often than primary insufficient milk supply, because indicators of insufficient milk supply which are often reported by mothers, such as infant crying, fussiness and

wakefulness are not reliable indicators of milk supply. Such indicators can be related to receiving insufficient milk by the infant and also can be related to normal behaviours of the infant (Gatti, 2008; Kent et al., 2012). Hence, to avoid perceived insufficient milk supply and increase the rate of BF, it seems that women may need to be educated to know some signs of normal BF (Heath et al., 2002). For instance, signs that BF is adequate (after 4^{th} day) include wet diapers $\geq$ 6/day and the breast becoming softer and lighter as the feeding session progresses (Smith & Tully, 2001).

Another important biological factor affecting BF in NZ is maternal smoking. Maternal smoking has been identified by several studies as being associated with shorter BF duration (Ford et al, 1994; Butler et al., 2002 & 2004). Women who smoked more than 20 cigarettes daily were twice as likely to give up BF after leaving hospital (Ford et al., 1994). The 2012 report of the Growing Up in NZ indicated that 11% of women smoked when they were pregnant, and this increased to 14% by the time of the infant was nine months old **(**Morton et al., 2012).

Maternal obesity has been associated with a delayed lactogenesis II (which occurs usually by approximately four days after birth, when the milk secretion increases (Hill et al., 1999; Kent, 2007)) and lower milk production, and therefore can lead to early cessation of BF (Amir & Donath, 2007). Another important physical factor which has been identified in NZ women is maternal pain during lactation (sore breasts) (Butler et al., 2002; Heath et al., 2002). Some delivery methods and practices have also been associated with reduced BF duration. These include caesarean delivery (Butler et al., 2004) and the use of epidural pain relief (Henderson et al., 2003). The majority of NZ women (around 66%) have a spontaneous vaginal delivery (Morton et al., 2012).

2.2.2 Social factors

Social factors also influence the duration of BF. Maternal support and information have an important effect on BF practices and duration. In western countries, a number of social factors have been identified as having a negative impact. In the early and middle part of last century, western doctors played a large role in the "medicalization" of BF, and women's attempts to breastfeed were often undermined by advice from their doctor to bottle feed (Ryan & Grace, 2001). In NZ, medicalization was associated with hospitalization of women for childbirth and health professionals advocating strictly timed feeding regimes (Ryan & Grace, 2001).

The Growing Up in NZ study found women seek information and support from Plunket nurses, family and friends, books, internet and magazines, their GP and midwife, and to a lesser extent from pharmacists (Morton et al., 2012). The quality of this information is clearly essential. For example, amongst Pacific Island people in NZ, consulting a traditional healer tended to reduce the duration of BF (Butler et al., 2002). It was suggested that Pacific Island women need formal educational support for BF (Butler et al., 2002). Support from friends and family is also an important factor in promoting BF success, and in particular support from the partner (Thulier & Mercer, 2009). In a NZ study, 12% of mothers stated that their partner felt formula feeding or other alternative liquids feeding was more convenient than BF (Heath et al., 2002). This study suggested that enhancing partner support is important for NZ women to continue to breastfeed their baby.

Returning to work has been negatively associated with BF initiation and continuation (Chatterji & Frick, 2005; Rondo & Souza, 2007). The Growing Up in NZ Study found that 79% of women were in paid employment by the time their baby was nine

months old (Morton et al., 2012). Generally for a full-time job, NZ women have to work more than 35 hours/week (Statistics New Zealand, 2005). They are enabled by law to have paid parental leave for 14 weeks when they meet certain criteria. They are also able to extend such leave period without pay till 52 weeks postpartum (Ministry of Business, Innovation and Employment, 2012). Women in NZ also expect to take leave when the baby is born. The Growing Up in NZ study reported that more than 95% of women with paid employment during the pregnancy intended to take parental leave, with eight to nine months (the average expectation) (Morton et al., 2010).

Cultural differences also influence BF duration. Maori, Pacific Island and Asian women in NZ have a lower rate of BF than European. In 2009, the rate of exclusive and full BF for infants aged from 2-5 weeks was 59% in the Maori population, 54% in the Pacific population, 60% in the Asian population, and 70% in the rest of the population (mostly European). Between 16 weeks to 7 months the rate of exclusive and full BF was 19% in the Maori population, 20% in the Pacific population, 19% in the Asian population, and 30% in the rest of the population (Plunket Society, 2010). This is in contrast to the historical situation of Maori before European colonization, when all infants were breastfed and lactating mothers were valued and supported. From colonial times, Maori and Pacific Islanders tend to have a lower socioeconomic status than other ethnic groups, which could also have the effect of reducing BF rates (National Breastfeeding Advisory Committee, 2007).

2.2.3 Psychological factors

Factors which have been associated with successful BF include a mother's interest and confidence in BF, her intention to breastfeed (Morton et al., 2012) and belief that she can do it (self-efficacy) (National Breastfeeding Advisory Committee, 2007). Some factors which have been found to work against BF include embarrassment at feeding, particularly in public, lack of confidence and negative attitude (Heath et al., 2002); Stress, postnatal depression and tiredness also contribute to lack of initiation or early cessation of BF (Butler et al., 2002; Morton et al., 2012).

Perceived insufficient milk supply is also related to psychological factors. In a review by Gatti (2008), perceived insufficient milk was found to be significantly associated with low scores of maternal satisfaction, confidence and self-efficacy. Meedya et al. (2010) indicated that maternal self-efficacy was positively associated with perceived sufficient milk supply.

2.2.4 Demographic factors

Demographic factors are well documented to have an association with BF practices. Callen and Pinelli (2004) reported that in western countries (US. Canada, Europe and Australia) maternal education, age, marital status and family income were associated with BF practice. Women, who were older and married, had better education and higher family incomes were more likely to initiate and continue to breastfeed their babies. These findings were consistent with another review article (Meedya et al., 2010). In the Growing Up in NZ Study, NZ mothers with higher educational qualifications were more likely to plan to BF their infants (Morton et al., 2010), and

younger single mothers were more vulnerable to early cessation of BF than others (Morton et al., 2012).

2.3 Breastfeeding patterns

2.3.1 Establishing & controlling breastmilk supply

In NZ, the BF initiation rate is high. However, BF rates decrease dramatically after the first six weeks and do not meet the target set by the NZ Ministry of Health (Ministry of Health, 2002). An insufficient milk supply was reported by New Zealanders to be one of major reasons for stopping BF (Morton et al., 2012).

The initiation and maintenance of lactation requires hormones and effective emptying of the breasts (Hill et al., 1999). There are many hormones involved in lactation, including insulin, thyroid hormones, and cortisol, but the particularly important hormones are prolactin and oxytocin. Prolactin stimulates the initiation of milk synthesis, and is released in response to breast stimulation. The amount of prolactin secreted depends on BF frequency and suckling duration (Hill et al., 1999). In the first few days, night feeds are suggested to increase prolactin (Price & Bamford, 1984).

Oxytocin is released each time the baby suckles (Hill et al., 1999), and stimulates milk ejection (Kent et al., 2007). It is suggested that effective milk ejection helps the drainage of the breast, which then leads to increasing milk production (Kent et al., 2012). The well emptied breast results in a higher rate of breastmilk synthesis, compared to when the breast is not well emptied (Kent et al., 2012). One study found that when the interval between BF was longer than six hours, the rate of

breastmilk synthesis during the period between breastfeeds had a significant decline (Daly et al., 1996). The reason suggested by researchers is that when the breast is well drained, this may help to remove feedback inhibitor (Kent et al., 2012). Early frequent BF and unlimited skin to skin contact facilitate effective breast drainage (Kent et al., 2012). Moreover, milk production is also influenced by other factors such as the breast's ability to store milk the infant's stomach capacity and speed of gastric emptying owing to its impacting on milk intake by the infant (Kent et al., 2012; Prime et al., 2012). The basic determinant of milk volume is the infant's demand (Darragh & Lönnerdal, 2011). Hence, the infant has a controlling role in milk production.

The first several weeks are the critical period to establish lactation (Kent et al., 2012). If lactation is well-established, the mother will be able to fully breastfeed the baby, with no need for formula supplementation (Fildes, 1986). During this period, BF practices can have an influence on lactation establishment and subsequent milk production (Yamauchi et al., 1990; Hill et al., 1999; Kent et al., 2012). It appears that frequent BF is necessary to achieve successful lactation (De Carvalho et al., 1983; Hill & Humenick., 1989), which may be due to frequent BF increasing the level of maternal prolactin (Lang, 2002), and increasing the drainage of the breasts (Kent et al., 2012; Prime et al., 2012). It is generally advised that long intervals between BF should be avoided during the early period postpartum (Lang, 2002). However, the length of intervals between BF that could negatively influence milk production lacks scientific support. One Australia study indicated that longer than six hours between BF had a significant decline in the rate of breastmilk synthesis during the period between breastfeeds (Daly et al., 1996). The reason is that the

higher degree of the breast fullness can result in less complete drainage of the breast, therefore lead to autocrine inhibiting milk synthesis (Prime et al., 2012).

2.3.2 What patterns increase breastmilk production and breastfeeding duration?

2.3.2.1 Early initiation

BF behaviours immediately after birth are associated with BF duration. In an early study (Salariya et al., 1978), women were randomly assigned to one of four groups and directed to either feed their babies within 10 minutes after birth or 4-6 hours after birth, and then either two hourly after that or four hourly. Both earlier initiation and more frequent feeding increased breastfeeding duration, with the group who initiated early and fed more frequently feeding for the longest (Salariya et al., 1978). Another study also reported that BF initiation within 16 hours of the birth had a positive correlation with BF duration (Feinstein et al., 1986).

2.3.2.2 Breastfeeding frequency

In the middle of the 18th century, in some wealthy English speaking countries, scheduled BF (4-6 feeds per day) was common, but this did not widely spread or become practised throughout the world. Before this, demand feeding was the most common practice (Fildes, 1986; Manz et al., 1999). "Demand feeding" means BF a healthy, full-term infant on demands based on signs from the infant (Lang, 2002). It is assumed the infant will demand BF when they are hungry and thirsty (Price &

Bamford, 1984). However, demand feeding also needs the mother to be involved as an active participant interpreting the infants' signs (Manz et al., 1999). Manz et al. (1999) stated that during the 1960s and 1970s, a return to demand feeding was advocated (Manz et al., 1999).

Concerning specific BF practices, there are only a few studies that have observed BF frequency and feeding patterns in detail beyond the first week. A valuable study was conducted in Sweden by Hörnell and his colleagues (1999). This study examined the frequency of exclusive BF. The frequency of breastfeeds was described separately for daytime, night time and 24-h from 2-26 weeks postpartum. Specifically, during daytime, the range of BF frequency/day was from about 3-11 at two weeks and about 3-9 at 20 weeks; during night time feeds, the range was from about 1-5 at two weeks and about 0-4 at 20 weeks; during the 24 hour-period, the range was from around 4-15 at two weeks and about 4-11 at 20 weeks. The median number of breastfeeds was about eight times/day from 2 to 20 weeks, with about six breastfeeds during the daytime, and about two breastfeeds during night-time.

An Australian study found that infants aged between 1-6 months were exclusively breastfed 11±3 times/day (Kent et al., 2006). A U.K. study showed that exclusively-BF infants were fed 5-12 times/day with the median 8 times/day at 15 weeks; and median 7 times/day at 25 weeks, with the range 4-20 times/day (Nielsen et al., 2011). A U.S. study found The median number of breastfeeds per day was between 6-8 times/day during the first 26 weeks postpartum, subsequently down to 3.5 times/day at 48 weeks (Shealy et al., 2008).

There is a range of advice to guide the mother on how to practice BF, but most is not directly based on scientific evidence. Fildes (1986) and Lang (2002) advise that if the baby is breastfed about every two hours during the day-time and one or two times at night, this may be enough to meet the infant's needs during the early months postpartum. Price and Bamford (1984) suggest that it is not good to feed the new baby more frequently than 3-4 hours between breastfeeds. Lang, (2002) state that numerous infants do finally establish a BF pattern of 6 to 8 feeds daily, with more feeds often needed towards the night, but BF frequency may vary greatly between individual infants. For working women, Price and Bamford (1984) suggest that at least four breastfeeds/day are required to maintain sufficient milk production. The NZ Ministry of Health (2012a) recommends that healthy breastfed neonates may need to breastfeed 3-8 times in the first 24 hours, and 5-10 times or more from day two to day six. Recent common advice concerning BF frequency is 8-12 times daily during the early period of lactation to establish and maintain breastmilk production (Gartner et al., 2005; Shealy et al., 2008; Kent et al., 2012).

Although early frequent feeding has been widely advocated, a recent survey of mothers in the U.K. found frequent BF was a top reason to cease BF — 71% of women reported cessation of BF by six weeks, and 55% of women reported by four months (Wright et al., 2006). In this study, mothers were asked to fill out a questionnaire about BF and their baby's health. Mothers who had stopped BF were asked to choose from six possible reasons they stopped (Wright et al., 2006). Closed questions on surveys can introduce bias by suggesting answers to the participants, so these results are biased, however the results indicate that some women are discouraged from BF if it is very time consuming for them. This may have implications for recommendations about BF frequency. For some mothers, very

frequent BF may not always be the best choice, and it may not be necessary for mothers who already have a good milk supply. If mothers are stressed, this will reduce their milk supply, so in this situation rest and support may be more important than very frequent BF (Moreno-Villares & Galiano-Segovia, 2013).

2.3.2.3 Breastfeeding sessions

There are limited studies which have looked at BF sessions in detail. Hörnell et al., (1999) reports on BF sessions in exclusively breastfed infants during different time frames. The median BF session was similar for daytime and night-time (at 2 weeks: 17 & 16 minutes; at 20 weeks: all 10 minutes). However, the median total length of BF sessions during the nighttime was shorter than that during daytime, due to more feeds during the daytime (at two weeks: 32 minutes vs. 1hours 32 minutes; at 20 weeks: 18 minutes vs. one hour).

Shealy et al. (2008) reports on BF sessions from the infants' birth to one year old. In this study most of the BF sessions reported by mothers were less than 20 minutes (about 45%-90% from 1-12 months), and least reported were more than 40 minutes (about 10%- 3% from 1-12 months). There was a significant increase in BF sessions less than 10 minutes from 1-12 months (from about 5%-40%). Another recent study conducted in U.K. involved exclusively breastfed infants also found for the majority infants the duration of their average BF session was less than 29 minutes at 15 and 25 weeks (90% and 89%, respectively) (Nielsen et al., 2011).

Suckling duration per feed has not been shown to be correlated with breastmilk production or infant intake, however unlimited suckling time, which may result in better drainage of the breast, may facilitate milk production (De Carvalho et al., 1982;

De Carvalho et al., 1983; Kent et al., 2012; Prime et al., 2012). A recent study of mothers who were expressing breastmilk suggested that long expression duration ($\geqslant$ 15 minutes, by electric breast pump) may be not necessary for most women who have enough milk production, although the period of time required for complete milk removal may vary by method of removing milk e.g. electric breast pump vs. milk removal by the infant (Prime et al., 2012).

However, short BF session is suggested as one of the reasons women stop BF (Hytten et al., 1958). For example, a study conducted in U.K. found infants who refused the breast or who BF only 1-4 minutes at a session resulted in the mother stopping BF because they thought they did not supply enough milk to their infant, or that the infant did not have the ability to suckle properly (Hytten et al., 1958). Shealy et al. (2008) states that common advice concerning suckling duration is 10-15 minutes at each side per feeding session.

2.3.2.4 Intervals between breastfeeds

Consistent findings show that the duration of the interval between feeds has a positive association with the age of the infant (Hörnell et al., 1999 & 2001; Shealy et al., 2008). For exclusively breastfed infants, the longest interval increased from around two hours at one month to around four hours at about seven months (Shealy et al., 2008). Concerning the association between BF intervals and milk production or BF duration, there is little evidence. However, normally it is considered that avoiding long intervals between feeds and giving regular BF may improve BF practices (Lang, 2002), in order to drain the breast and then provide positive feedback for milk synthesis (Prime et al., 2012).

2.3.3 What patterns decrease breastmilk production and breastfeeding duration?

2.3.3.1 Early introduction of formula

Supplementary formula is associated with a shorter BF duration (Hill et al., 1997; Riva et al., 1999; Dennis, 2002; Smith et al., 2002; Taveras et al., 2004; Pontin et al., 2007; Thulier & Mercer, 2009). A U.S. study showed women who were recommended formula supplementation by clinicians had a higher risk of cessation of exclusive BF by 12 weeks (Taveras et al., 2004). Another U.S. study observed that mothers' belief that infants enjoy formula feeding by mothers was significantly associated BF cessation at two weeks (Ertem et al., 2001). A Western Australian study found that feeding an infant breastmilk combined with formula feeding significantly predicted stopping any BF by nine weeks (Hauck et al., 2011).

Introducing formula during the first four weeks postpartum may have a worse effect on BF duration than later introduction of formula, because lactation is being established during this period. One study showed that adding formula within the first month shortened BF duration regardless of other fluid intake such as water or herbal teas ($P<0.001$) (Giugliani et al., 2008). An early U.S. study reported that the risk of BF cessation at four months increased three folds when formula was introduced more than once every day in the first month after the birth (Feinstein et al., 1986). A NZ study also found similar results (Vogel et al., 1999). It stated that if formula was introduced within the first month, it increased by 3.1 times the risk of BF cessation by 12 months (Vogel et al., 1999). A recent U.S. study not only emphasised that introducing formula feedings at day four postpartum increased the

risk of ceasing BF, but also emphasised that it was related to a high incidence of sick visits to health care clinics in the first month (Bunik et al., 2010).

2.3.3.2 Early introduction of other solids and liquids

Early introduction of CF may be correlated with early cessation of BF (Hytten et al., 1958; Ekstrom et al., 2003; Giugliani et al., 2008; Wijndaele et al., 2009), lower frequency of BF (Hornell et al., 2001; Lande et al., 2003), and shorter BF session (Hornell et al., 2001). It is also reported that early introduction of CF was associated with BF difficulties that are risk factors related to early cessation (Wright et al., 2006).

According to reports of the Ministry of Health, NZ mothers prefer to introduce CF from about the age of four months, although they knew six months was recommended rather than four months (Ministry of Health, 2008 & 2012b). Hence, it is apparent that the NZ infant may be fed inappropriately, due to introduction of supplemental foods before four months (Heath et al., 2002). This situation is also common in most of European countries (Caroli et al., 2012). A study conducted in the U.K. showed that the majority of infants were introduced to CF and formula before four months. The rate of exclusive BF decreased greatly from 54.8% at the first month to 9.6% at the fourth months, owing to introducing CF to the infants (Pontin et al., 2007). The United States had a similar situation to the U.K. A large U.S. cohort study in 2008 reported that more than 50% infants were fed CF before four months. Those infants were more likely to stop BF at six months, compared to the infants who were not fed CF at four months (70% vs. 34% stop BF at six months)

(Grummer-Strawn et al., 2008). A similar finding was reported by a Norwegian study (Lande et al., 2003).

2.4 Summary

Breastmilk is the ideal food for the infant. It can provide all required nutrients during the first six months postpartum as well as bioactive components, and thus benefit infants' growth, development and health. Exclusive BF is recommended to around six months, and then introducing CF and continuing BF until 12 months or beyond is recommended by NZ Ministry of Health (2011). A large part of NZ infants do not meet these recommendations. The prevalence of exclusive/full BF till six months and BF till 12 months are low and have not reached the target that the Ministry of Health set in 2002. Hence, promoting exclusive/full and BF duration in NZ is necessary. According to documented studies, BF duration is influenced by many factors, but perceived insufficient milk supply is a major barrier to BF continuation. Therefore, promoting milk production may be important to prolong BF duration.

With regard to BF practices, based on the literature, it seems that to increase BF duration the infant may need to be fed as soon as possible after the delivery. The first month is a key period of establishing lactation, during which time feeding practices are important, especially, where there are concerns about inadequate milk supply. The following factors may be important to promote milk production and achieve six months of exclusive BF duration and BF until one year: frequent BF, avoiding long intervals between BF, not introducing formula and supplemental foods during the first several weeks.

2.5 Aims

The aim of this study is to describe BF patterns (frequency, longest interval and length of BF session), and to observe the association between BF duration and BF patterns. Little work has been carried out on BF practices in detail within NZ.

Objectives:

1) To describe BF patterns during the first 12 months — including frequency, longest interval between BF and the length of BF session;

2) To observe the association between BF duration and frequency of BF in the first month;

3) To observe the association of maternal and infant characteristics with full BF/any BF duration;

Chapter Three Methodology

3.1 Subjects recruitment

This thesis is a secondary data analysis of data collected as part of the Manawatu Mother and Baby study. Pregnant women were recruited into this study in the last stage of gestation (≥35 weeks), no younger than 16 years old, and having a healthy pregnancy and healthy infant. Full-term infants were defined as having at least 37 weeks of gestation, and normal-birth weight infants were defined as birth weight ≥2500g birth weight (Ministry of Health, 2012c). Participants were recruited by advertisements in the Manawatu, NZ, by newsletters, webpage, and in locations such as GP surgeries, midwifery premises and Plunket rooms.

Sixty one participants were recruited. The majority of them were from Palmerston North. Ethical approval was obtained from the Massey University Human Ethnics Committee: Southern A: 06/70, Palmerston North, NZ.

3.2 Data collection

Women were interviewed about BF practices at approximately 2 weeks after birth and then at 2 weekly intervals during the first three months, and then once per month in the remaining 9 months until the infants first birthday. Most interviews were conducted through telephone by a trained interviewer, but 59% of participants came to the Human Nutrition Lab in Massey University, Palmerston North at the time of

recruitment for body composition measurements, and some interviews were conducted in person at that time.

3.2.1 24-hour recall

A questionnaire was used to collect information about the mothers' demographics and obstetric characteristics (See Appendix A). This was usually completed in the final trimester of pregnancy. Information about the infants' birth status, BF problems and advices were obtained at two weeks postpartum using a questionnaire; and detailed description of infant feeding and sleeping was collected by the interviewer using a 24-hour recall template (See Appendix B). All the infant's activities of the previous 24 hours were recorded by the interviewer using the codes as shown in the coding table (see Appendix B). This included the activity (e.g. sleep, breastfeeding, cry, ect.), the time the activity begins, and, for food and drink, the amount consumed and the adult involved. The duration of an activity is taken as the time from the beginning of the activity until the next activity begins, unless two activities are explicitly stated to occur at the same time.

Recall data is widely used in anthropological studies to observe thoughts and activities (Bernard, 2011). In regards to examining infant feeding practices, the 24-hour recall is commonly chosen by researchers; mothers are asked how the infant was fed in previous 24 hours (Ziegler et al., 2006; Hector, 2011). The 24-hour recall has some advantages including minimizing respondent burden (Bernard, 2011), and many important indicators for BF practice and policy can be targeted by a few questions (Hector, 2011).

However, there are some limitations with this method. First of all, the 24-hour dietary recall is a retrospective method, it may have recall bias (Agampodi et al., 2011), which may be influenced by some maternal factors such as age, mood, intelligence and attention (Krall et al., 1998). Accuracy of 24-hour recall can be enhanced when designed appropriately and structured questions are used (Agampodi et al., 2011). For example, Aarts et al. (2000) found that if mothers reported they fed their infants only by breastmilk during the previous 24 hours, they should be asked detailed questions, such as have ever introduced any other fluids or solids since the infant's delivery. If the answer was yes then need to ask further, such as how frequently the infant was fed those foods. Lastly, over reporting BF practices may arise from a bias of social desirability — women prefer to give a socially acceptable response, owing to awareness of BF recommendations (Li et al., 2005; Agampodi et al., 2011).

The 24-hour recall may overestimate the prevalence of exclusive BF, since a single 24-hour recall (without additional questions) does not show feeding practices during previous days, during which time the infants may be fed other foods in addition to breastmilk (Aarts et al., 2000; Binns et al., 2009; Agampodi et al., 2011; Hector, 2011). Hence, when using the 24-h recall method it may be better to refer to full BF instead of exclusive BF (Binns et al., 2009).

Based on above shortcomings, the instrument used for this study was more detailed than the usual 24-hour dietary recall. In this study, the mothers were asked to recall both was infant feeding and activity practices (recalling the last 24 hours feeding, sleeping and wakefulness). However, a disadvantage of this recall method is in later data analysis and interpretation, when it may not be straightforward to obtain the data as for specifically targeted questions. Finally, some related questions about BF

(maternal attitude, knowledge and intention towards BF) were asked at the same time as the 24-hour dietary recall to check the reliability of the data.

3.3 Handling of data

The questionnaires including the 24-hour recall were coded and entered into a data set for SPSS version 20.0.

3.3.1 Data cleaning & coding

- Firstly the data set was cleaned to make sure that values were correct and forms of values are appropriate to be used in analysis.

- The end of the 24 hours for each case was indicated with a data point coded as "99" which did not represent any activity. The reason is that this study was designed to look at infants' feeding behaviours in 24 hours via 24-hours recall, but collected data was not always recorded to finish at exactly 24 hours (exceed/ less 24 hours).

- The 24-hour recall was not always conducted on the exact anniversary of the infants birth, e.g. 2 weeks, 4 weeks. So the age at the interviews were coded corresponding with the age closest to the following age: 2 weeks, 4 weeks, 6 weeks, 8 weeks, 10 weeks, 12 weeks, 16 weeks, 20 weeks, 24 weeks, 28 weeks, 32 weeks, 36 weeks, 40 weeks, 44 weeks, 48 weeks.

- BF in some cases was reported to happen at the same time as other activities (such as fed the baby with CF, asleep, or fully awake and unsettled). Estimating actual length of BF session for these breastfeeds was based on the following rules after consultation with women experienced in breastfeeding.

- When BF was reported at the same time as feeding the baby with expressed breastmilk, or CF, or when the infant was asleep, or with fully awake and unsettled/ content, the actual length of BF sessions was estimated at 50% of original reported time by mothers;

- When BF was reported at the same time as co-sleeping, the actual length of BF sessions was estimated at 20% of original reported time by mothers;

- When BF was reported at the same time as comfort suckling, the actual length of BF sessions was estimated at 80% of original reported time by mothers.

3.3.2 Selecting participants for case study

The selected participants for case study were required to meet two criteria ─ one was that participants breastfed babies up to 48 weeks, and the other was that the number of breastfeeds/day during the first four weeks postpartum was outside the commonly advised range of 8-12 times/day as stated by Gartner et al. (2005), Shealy et al. (2008), and Kent et al. (2012). Among the participants who met these two criteria, two participants who reported less than eight breastfeeds/day at week 2 or 4 after the birth were randomly selected, and also randomly selected were another two participants who reported more than 12 breastfeeds/day at these times.

3.4 Data analysis

At each interview, infant feeding is categorised based on what the infant was fed on duration the previous 24 hours based on the following BF definitions of NZ Ministry of Health (2002));

1) Full breastfeeding — the infant was only fed by breastmilk including expressed milk or small amount of water/medicine, and no other liquids and foods in the past 24 hours;
2) Mixed feeding — the infant was fed breastmilk (could be expressed milk) and formula, and no other liquids and/or foods in the past 24 hours;
3) Mixed feeding with complementary foods — the infant was fed breastmilk (could be expressed milk) and formula, and also received other liquids and/or foods in the past 24 hours;
4) Breastfeeding with complementary foods — the infant was fed by breastmilk (could be expressed milk) and received other liquids and/or foods, but no formula in the past 24 hours;
5) Not breastfeeding — the infant was not given breastmilk including expressed milk, but given other alternative foods — formula and/or solids, and/or other liquids in the past 24 hours.

In addition, use of expressed breastmilk was noted — expressed breastmilk is counted as BF for frequency and interval analysis, but not for BF sessions.

Variables were calculated as follows:

1) Breastfeeding frequency was defined as the number of BF/24 hours

(including feeds of expressed milk).

2) The length of BF session was defined as from the beginning of a BF to the beginning of the following activity. The last BF in the 24 hours recall was not included in the analysis of length of BF session if the BF ended after the end of the 24 hours period.

3) The interval between BF is defined from the beginning of a BF to the beginning of the following BF (Marasco& Barger, n.d.). The interval after the last BF of the 24 hour recall is calculated from the beginning of the last BF to the beginning of the first BF in the 24-hour recall; this is an assumption that feeding practices were the same in the next 24 hours.

4) The longest interval between BF was the longest interval between two breastfeeds in 24 hours.

- Statistical Analyses

Results were described and analysed using SPSS version 20.0 (Statistics Package for the Social Sciences). A p-value ≤ 0.05 was considered to be significant. Normality of the data was tested using Shapiro-Wilk test and visual inspection of Q-Q plots. The data was not normally distributed after an attempt of a transformation. Therefore, the data was subjected to non-parametric tests.

Quartiles were calculated based on the method described in IBM (2013), and boxplots were created by using Tukey Hinges (IBM, 2011). The difference between groups was tested by Mann-Whitney U or Kruskal-Wallis. If a significant difference was detected, further post hoc test was carried out (IBM,

2012). The correlation between BF duration and BF frequency was tested by the Spearman's rank correlation coefficient, and visual inspection of scatter plots.

Chapter Four Result

4.1 Participants

A total of 61 participants took part in this study. The response rate for the interviews is shown in Table 4.1. Eighty-nine percent of the women completed the 12 months of the study.

Table 4.1. The number and percentage of respondents at each observed time point (approximate age of infants) during the first year postpartum

Weeks	N (Total n=61)	%
2	59	97
4	61	100
6	58	95
8	59	97
10	59	97
12	60	98
16	59	97
20	59	97
24	59	97
28	58	95
32	58	95
36	54	89
40	57	93
44	55	90
48	54	89

4.1.1 Maternal demographic characteristics

The mean age of participants was 32.1±0.6 years. The most common age of the women (47% women) was 30-34 years. Thirty-two percent of the women were aged

more than 35 years, 12% were aged 21-24 years, and 10% were aged 25-29 years. The mean height was 1.7±0.5 meters. Thirty six women (about 59% of the total) were assessed for their body composition. The mean weight was 85.4±13.6kg (about 2 weeks before the delivery) (Table 4.2).

The majority of participants (n=52) were NZ European. The remainder were NZ Maori (n=4) and European & Maori and others (n=4). Among participants, 45% of the women had at least a bachelor's degree. Concerning the living arrangement, 90% women lived with their partner, and 67% were living with their children (the rest were first time mothers) (Table 4.2).

4.1.2 Maternal obstetric factors and past feeding experience

Fewer women (33%) were primiparous while the majority were multiparous and 23% had at two or more children. Among multiparous women, 56% women breastfed their previous infant for more than 6 months, and 32% breastfed for more than 12 months. The remaining women had BF either less than 1 month (19%) or between 1-6 months (24%) (Table 4.2).

Regarding gestational period (about 59% mothers reported), most women (78%, n=28) had at least 37 weeks gestation. About 22% women (n=8) had less than 37 weeks. However, all infants were healthy and had no congenital malformations which could affect sucking ability. The majority of women had a vaginal delivery (72%), and the remaining (28%) had a caesarean delivery (Table 4.2).

4.1.3 Infant characteristics

The percentage of male infants was slightly higher (56%) than that of female infants (44%). Ninety-eight percent of the infants had a normal birth weight (≥2500g) and only 2% (n=1) had a birth weight less than 2500g (Table 4.2).

Table 4.2. Demographic and obstetric characteristics of participants and infants

	N (Total n=61)	%	Mean	(Std.Deviation)
Age (total)	60		32.1	0.6
21-24	7	12	22.6	1.1
25-29	6	10	27.7	1.6
30-34	28	47	31.9	1.4
>=35	19	32	37.2	2.2
Height (m)(total)	36	59	1.7	0.1
Weight (kg) (total)	36	59	85.4	13.6
Gestational Duration (total)	36		37.4	1.2
<37 preterm baby	8	22	35.8	0.9
≥37 full term baby	28	78	37.9	0.8
Parity (total)	60		1.0	0.8
0	19	32		
1	27	45		
≥ 2	14	23	2.2	0.4
No Breastfeeding Experience	19			
Past Breastfeeding Experience (total)	37			
breastfed < 1 mo (longest duration)	7	19		
breasttfed 1-6 months (longest duration)	9	24		
breastfed 6-12 months (longest duration)	9	24		
breastfed 12 months or more (longest duration)	12	32		
Mode of Delivery (total)	61			
Natural	44	72		

	N (Total n=61)	%	Mean	(Std.Deviation)
Cesarean	17	28		
Number Children Living With (total)	60			
0	20	33		
1	27	45		
2	9	15		
3	4	7		
Living with Partner (total)	60			
No	6	10		
Yes	54	90		
Education (total)	60			
<bachelor	33	55		
≥bachelor	27	45		
Ethnicity (total)	60			
NZ European	52	87		
NZ Maori	4	7		
NZ European/ Pakeha & NZ Maori & others	4	7		
Gender of Baby (total)	61			
Female	27	44		
Male	34	56		
Birth Weight of Baby (g) (total)	61		3664.5	469.7
<2500g low birth weight	1	2	2360.0	
≥2500g normal weight	60	98	3686.3	441.6

4.2 Infant feeding patterns

4.2.1 Breastfeeding practice

4.2.1.1 Infant feeding during the first 12 months

At first four weeks 81% and 82% infants were fully breastfed. At 16 weeks the infants were predominantly fully BF (61%). Subsequently, more and more infants were breastfed and give CF or formula, or no longer received breastmilk (Figure 4.1). At two weeks, 12% infants were BF and supplemented with formula, and this varied only slightly (between 8%-14%) up to 16 weeks. Ten percent of the infants were no longer BF at four weeks after the birth (7% at 2 weeks) (Figure 4.1& Table 4.3).

After 16 weeks, most of the breastfed infants were introduced to complementary foods (CF). Between 16-20 weeks, there was a great decline of the percentage of fully BF infants (from 61% to 37%), and mixed–fed infants (10% to 3%), while the percentage of infants who were fed CF along with BF or mixed feeding increased (BF with CF from 7% to 27%; mixed feeding with CF from 8% to 12%). During this period, the proportion of infants who were not BF was increased only slightly from 17% to 20%. At 24 weeks, only 7% infants were fully breastfed, 24% were not receiving any breastmilk, 14% were mixed fed with CF, while breastfed infants with CF became the predominant feeding method (56%) (Table 4.3 & Figure 4.1).

During the following 20 weeks until 44 weeks, the percentage of infants who were BF supplement with CF, increased from 27% to 49%. There was an increased percentage of infants who stopped BF (from 28% to 38%), while the percentage of mixed-fed infants with CF remained nearly stable (between 9%-13%). At 48 weeks,

52% infants were still breastfed; 41% BF and receiving CF and 11% mixed feeding and receiving CF (Table 4.3 & Figure 4.1).

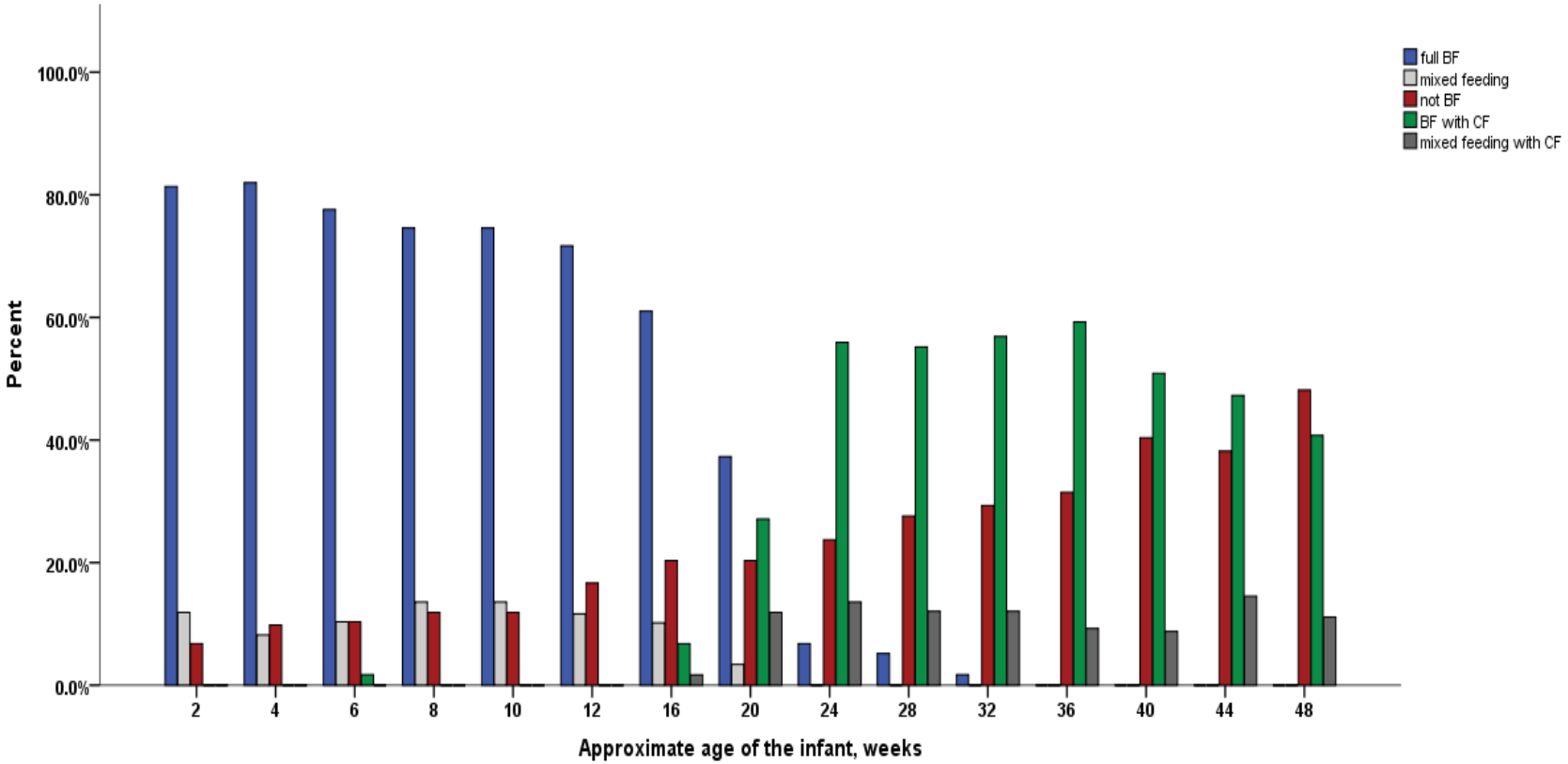


Figure 4.1. The percentage of breastfeeding among different feeding types at different ages

Note: BF: breastfeeding; CF: complementary foods.

Table 4.3. The number and percentage of breastfeeding among different feeding practices at different ages

Infant feeding method		***Approximate age of the infant, weeks***														
		2	**4**	**6**	**8**	**10**	**12**	**16**	**20**	**24**	**28**	**32**	**36**	**40**	**44**	**48**
Full BF	N	48	50	45	44	44	43	36	22	4	3	1	0	0	0	0
	%	81	82	78	75	75	72	61	37	7	5	2	0	0	0	0
Mixed feeding	N.	7	5	6	8	8	7	6	2	0	0	0	0	0	0	0
	%	12	8	10	14	14	12	10	3	0	0	0	0	0	0	0
Mixed feeding with CF	N.	0	0	0	0	0	0	1	7	8	7	7	5	5	7	6
	%	0	0	0	0	0	0	2	12	14	12	12	9	9	13	11
BF with CF	N.	0	0	1	0	0	1	4	16	33	32	33	32	29	27	22
	%	0	0	2	0	0	2	7	27	56	55	57	59	51	49	41
Not BF	N.	4	6	6	7	7	10	12	12	14	16	17	17	23	21	26
	%	7	10	10	12	12	17	20	20	24	28	29	32	40	38	48
Total	N. (100%)	59	61	58	59	59	60	59	59	59	58	58	54	57	55	54

Note: BF: breastfeeding; CF: complementary food

4.2.2 Breastfeeding frequency

4.2.2.1 Breastfeeding frequency per day during the first 12 months

As shown in Figure 4.2, over the first 12 months BF frequency was generally lower for mixed-fed infants with or without CF than for fully-breastfed infants or breastfed with CF. At two weeks, BF frequency for fully BF infants ranged from 5-21times/day with median nine times/day (interquartile range (IQR): 8-10 times/day). This was significantly different from mixed feeding infants who had fewer breastfeeds: from 1-15 times/day with median six times/day (IQR: 3-8 times/day). Between 4-12 weeks, the median BF frequency for fully breastfed infants was nearly stable between 9-10 times/day (IQR: 6.8-12 times/day), which was significantly higher than for infants who were being fed both breastmilk and formula (mixed feeding) who had median BF frequency between 5-6 times/day (IQR: 1-8.5 times/day) (Figure 4.2 & Table 4.4).

By 16 weeks, four infants had been introduced to CF to supplement BF; their median BF frequency was nine times/day (IQR: 9-12 times/day) (Figure 4.2). At 16 weeks, fully breastfed infants had a statistically significant higher BF frequency per day (median 9.5 times/day; IQR: 7-11 times/day), compared to mixed feeding infants (median 6.5 times/day; IQR: 4.5-7.3 times/day). At 20 weeks, there was a dramatic increase in the number of breastfed infants who were given CF (from four infants at 16 weeks to 16 infants at 20 weeks). Their BF frequency was not significantly different (median 7 times/day, IQR: 6-9.8 times/day) for infants fully BF or for mixed fed infants with CF (Figure 4.2 & Table 4.4).

At 24 weeks, all mixed-fed infants received CF. There were four fully BF infants and the 33 other breastfed infants also received CF. The median BF frequency for fully breastfed infants was 7.5 times/day (IQR: 6.3-11.8 times/day), which was similar to the number of feeds received by breastfed infants also receiving CF (median 7 times/day; IQR: 6-10.5 times/day) (Figure 4.2), while for mixed feeding infants receiving CF, there was a significant lower number of breastfeeds per day (median 3.5 times/day; IQR: 1.5-5.8 times/day) (Table 4.4). Through the following weeks till 48 weeks, for BF infants with CF, the median BF frequency varied between 4.5-7 times/day; and for mixed feeding infants receiving CF, median BF frequency varied between 2-6 times/day. Additionally, during this period at 50% of time points, there was a statistically significant lower BF frequency among infants who were mixed feeding and also receiving CF than among BF infants receiving CF (Table 4.4 & Figure 4.2).

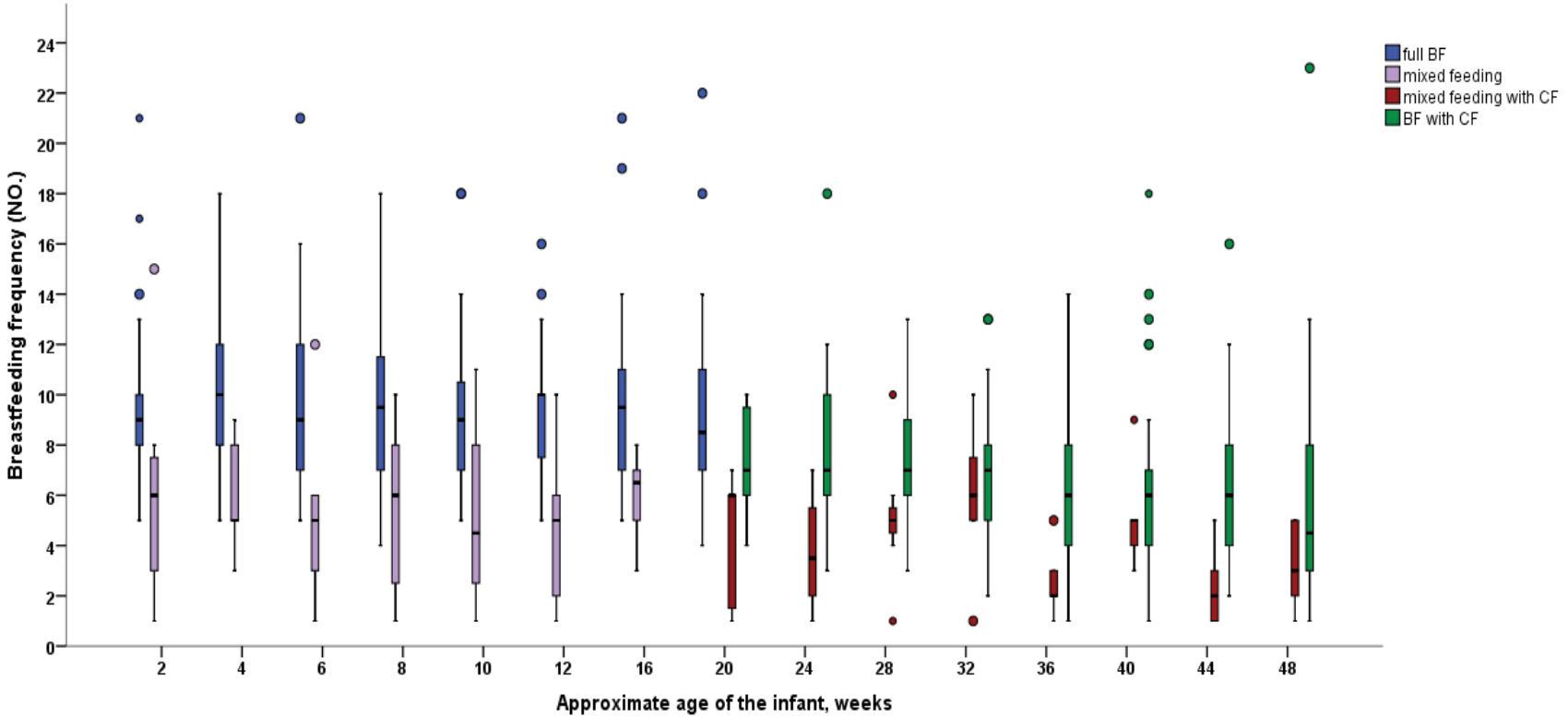


Figure 4.2. Breastfeeding frequency per 24 hours among different feeding practices during the first 12 months of infants age (Median, 25th and 75th percentiles and range) (excluding groups with less than 5 participants)

Note: BF: breastfeeding; CF: complementary foods; Breastfeeding frequency includes feeding at the breast and feedings of expressed milk.

Table 4.4. Breastfeeding frequency per 24 hours among different feeding types during the first 12 months

Weeks	Feeding Patterns	No. (women)	BF Frequency (NO.) Percentiles		
			25	50 (Median)	75
2*	Full BF[a]	48	8.0	9.0	10.0
	Mixed feeding[b]	7	3.0	6.0	8.0
	Total	55			
4*	Full BF[a]	50	7.6	10.0	12.0
	Mixed feeding[b]	5	4.0	5.0	8.5
	Total	55			
6*	Full BF[a]	45	7.0	9.0	12.0
	Mixed feeding[b]	6	2.5	5.0	7.5
	BF with CF×	1	9.0	9.0	9.0
	Total	51			
8*	Full BF[a]	44	7.0	9.5	11.8
	Mixed feeding[b]	8	2.3	6.0	8.5
	Total	52			
10*	Full BF[a]	44	7.0	9.0	10.8
	Mixed feeding[b]	8	2.3	4.5	8.0
	Total	52			
12*	Full BF[a]	43	7.0	10.0	10.0
	Mixed feeding[b]	7	1.0	5.0	6.0
	Total	50			
16*	Full BF[a]	36	7.0	9.5	11.0
	Mixed feeding[b]	6	4.5	6.5	7.3
	Mixed feeding with CF×	1	8.0	8.0	8.0
	BF with CF×	4	9.0	9.0	12.0
	Total	47			
20#	Full BF[a]	22	6.8	8.5	11.0
	Mixed feeding×	2	5.0	6.0	
	Mixed feeding with CF[b]	7	1.0	6.0	6.0
	BF with CF[ab]	16	6.0	7.0	9.8
	Total	47			
24*	Full BF×	4	6.3	7.5	11.8
	Mixed feeding with CF[a]	8	1.5	3.5	5.8
	BF with CF[b]	33	6.0	7.0	10.5
	Total	45			
28*	Full BF×	3	6.0	10.0	.
	Mixed feeding with CF[a]	7	4.0	5.0	6.0
	BF with CF[b]	32	6.0	7.0	9.0
	Total	42			

Weeks	Feeding Patterns	No. (women)	BF Frequency (NO.) Percentiles		
			25	50 (Median)	75
32*	Full BF×	1	22.0	22.0	22.0
	Mixed feeding with CF[a]	7	5.0	6.0	8.0
	BF with CF[a]	33	5.0	7.0	8.5
	Total	40			
36*	Mixed feeding with CF[a]	5	1.5	2.0	4.0
	BF with CF[b]	32	4.0	6.0	8.0
	Total	37			
40*	Mixed feeding with CF[a]	5	3.5	5.0	7.0
	BF with CF[a]	29	4.0	6.0	7.0
	Total	34			
44*	Mixed feeding with CF[a]	7	1.0	2.0	3.0
	BF with CF[b]	27	4.0	6.0	8.0
	Total	34			
48*	Mixed feeding with CF[a]	6	1.8	3.0	5.0
	BF with CF[a]	22	3.0	4.5	8.3
	Total	28			

Note: BF: breastfeeding; CF: complementary foods

*Mann-Whitney Test; #Kruskal Wallis Test;

a-b feeding patterns in a column followed by different superscripts are significantly different in mean rank at the significant level of $P < 0.05$.

× feeding patterns in a column not include in analysis (less than 5 participants);

Breastfeeding frequency includes feeding at the breast and feedings of expressed milk.

4.2.3 Longest interval between breastfeeds

4.2.3.1 Longest interval between breastfeeds per day during the first 12 months

Throughout the first 12 months, the range of the longest interval between breastfeeds remained wide (especially for mixed feeding infants) from approximately three hours to 24 hours (24 hours owing to one breastfeed/day) (Figure 4.3). At two weeks, the longest interval between BF for fully BF infants ranged between 3-10 hours with median 4.9 hours (IQR: 4.3-5.5 hours). The median for infants who were mixed feeding was 6.5 hours, and there was even greater variation in this group between 4-24 hours (IQR: 4.1-20 hours). Between 4-12 weeks, the longest interval for fully BF infants (median between 5.0-7.9 hours) was generally significantly shorter than for mixed-fed infants (median between 8.3-14.3 hours) (Figure 4.3 & Table 4.5).

At 16 weeks, the length of the longest interval between BF was a statistically significant different between fully breastfed infants (median 6.8 hours; IQR: 5.1-8.9 hours) and mixed-fed infants (median 11.2 hours; IQR: 6.6-14.4 hours) (Figure 4.3 & Table 4.5). Over the remaining 32 weeks, the longest interval increased so that by 48 weeks the median was 10.9 hours for mixed-fed infants received CF (IQR: 9.6-15.5 hours), and was 10.8 hours for BF infants receiving CF (IQR: 6.4-12.5 hours). The range still remained wide throughout the second half of the first year (Figure 4.3).

Over the 48 weeks, generally the longest interval between BF was longer for infants who were BF and supplemented with formula compared to fully BF infants. There

was also more variation in the length of the longest interval between BF for infants receiving breastmilk and formula as compared to fully BF (Figure 4.3 & Table 4.5).

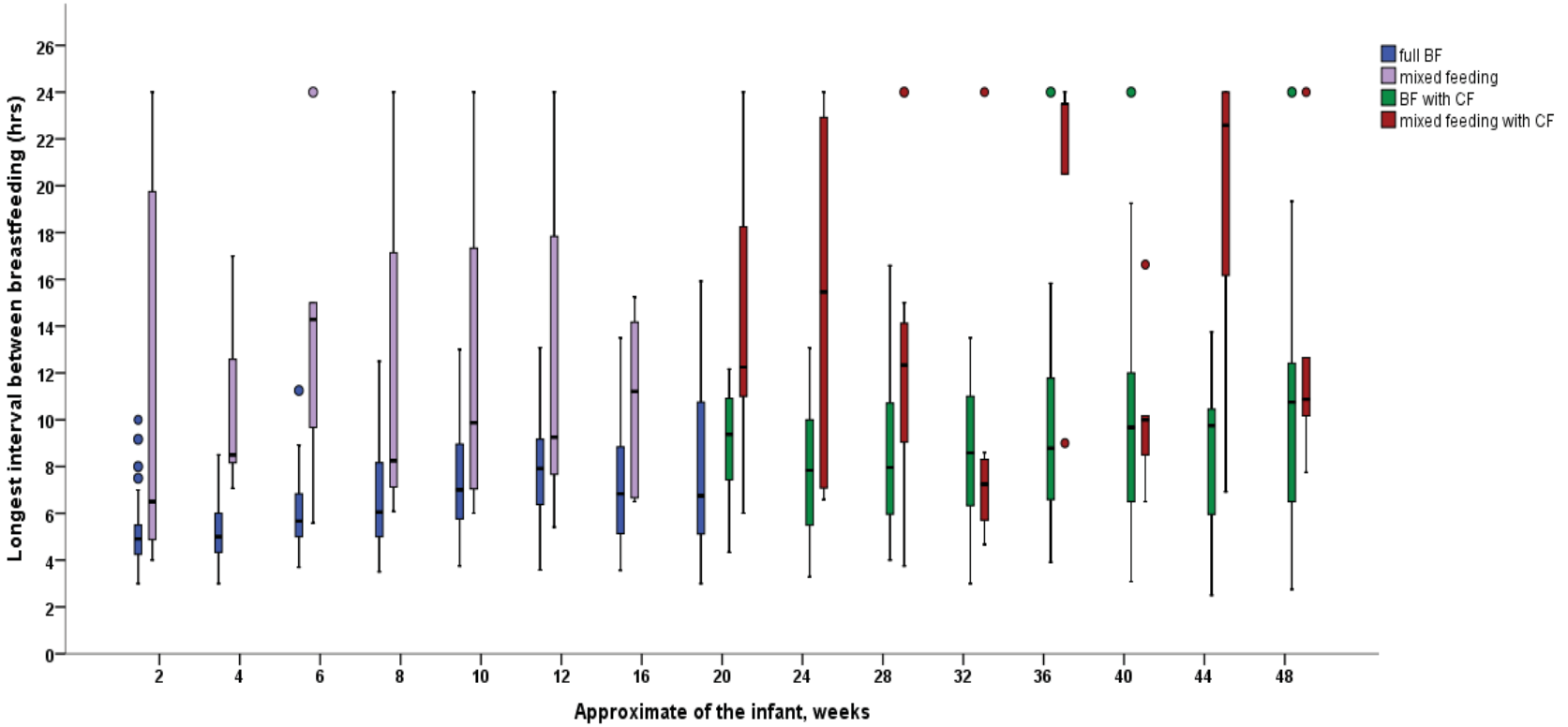


Figure 4.3. The longest interval between breastfeeds (hours) during 12 months among different feeding types (Median, 25th and 75th percentiles and range) (excluding groups with less than 5 participants)

Note: BF: breastfeeding; CF: complementary foods; Breastfeeding includes feeding at the breast and feedings of expressed milk.

Table 4.5. The longest interval between breastfeeds (hours) among different feeding types during the first 12 months

Weeks	Feeding Patterns	No. (women)	Longest Interval between BF (hours)		
			Percentiles		
			25	50 (Median)	75
2*	Full BF[a]	48	4.3	4.9	5.5
	Mixed feeding[a]	7	4.1	6.5	20.0
	Total	55			
4*	Full BF[a]	50	4.3	5.0	6.0
	Mixed feeding[b]	5	7.6	8.5	14.8
	Total	55			
6*	Full BF[a]	45	5.0	5.7	7.0
	Mixed feeding[b]	6	8.7	14.3	17.3
	BF with CF×	1	6.0	6.0	6.0
	Total	52			
8*	Full BF[a]	44	5.0	6.1	8.3
	Mixed feeding[b]	8	6.8	8.3	17.8
	Total	52			
10*	Full BF[a]	44	5.7	7.0	9.0
	Mixed feeding[b]	8	6.9	9.9	19.0
	Total	52			
12*	Full BF[a]	43	6.3	7.9	9.3
	Mixed feeding[a]	7	6.6	9.3	19 .0
	Total	50			
16*	Full BF[a]	36	5.1	6.8	8.9
	Mixed feeding[b]	6	6.6	11.2	14.4
	Mixed feeding with CF×	1	6.0	6.0	6.0
	BF with CF×	4	4.9	8.4	9.2
	Total	47			
20#	Full BF[a]	22	5.1	6.8	11.1
	Mixed feeding×	2	13.1	13.4	
	Mixed feeding with CF[b]	7	10.6	12.3	19.0
	BF with CF[ab]	16	7.0	9.4	11.1
	Total	47			
24*	Full BF×	4	5.3	7.9	11.4
	Mixed feeding with CF[a]	8	7.0	15.5	23.5
	BF with CF[b]	33	5.2	7.8	10.3
	Total	45			

Weeks	Feeding Patterns	No. (women)	Longest Interval between BF (hours)		
			Percentiles		
			25	50 (Median)	75
28*	Full BF×	3	3.1	5.5	.
	Mixed feeding with CF[a]	7	11.3	12.3	15.0
	BF with CF[a]	32	5.8	8.0	10.7
	Total	42			
32*	Full BF×	1	3.7	3.7	3.7
	Mixed feeding with CF[a]	7	5.8	7.3	8.6
	BF with CF[a]	33	6.2	8.6	11.3
	Total	41			
36*	Mixed feeding with CF[a]	5	14.8	23.5	23.8
	BF with CF[b]	32	6.6	8.8	11.8
	Total	37			
40*	Mixed feeding with CF[a]	5	7.5	10.0	13.4
	BF with CF[a]	29	6.0	9.7	12.1
	Total	34			
44*	Mixed feeding with CF[a]	7	12.8	22.6	24.0
	BF with CF[b]	27	5.9	9.8	10.5
	Total	34			
48*	Mixed feeding with CF[a]	6	9.6	10.9	15.5
	BF with CF[a]	22	6.4	10.8	12.5
	Total	28			

Note: BF: breastfeeding; CF: complementary foods;

*Mann-Whitney Test; #Kruskal Wallis Test;

a-c median values in a column followed by different superscripts are significantly different in mean rank at the significant level of $P< 0.05$.

× feeding patterns in a column not include in analysis (less than 5 participants)

Breastfeeding includes feeding at the breast and feedings of expressed milk.

4.2.4 Length of breastfeeding sessions

4.2.4.1 Length of breastfeeding sessions during the first 12 months

During the first 12 months, the length of individual BF sessions varied widely (Figure 4.4 & Figure 4.5). At two weeks, for fully BF infants, the length of BF session was 12-30 minutes/feed (IQR) with median 20 minutes/feed (the range: 2-205 minutes/feed). There was also wide variation for infants who were mixed feeding — IQR: 20-30 minutes/feed with median 20 minutes/feed (the range: 7.5-60 minutes/feed) (Figure 4.4, Figure 4.5 & Table 4.6). From 4-12 weeks, there was generally no significant difference of the length of BF sessions between fully BF infants (median from 19-15 minutes/feed; most feeds ranged between 1-60 minutes/feeds) and mixed-fed infants (median 20 minutes/feed; most feeds ranged between 2-45 minutes/feeds) (Figure 4.4 & Table 4.6).

At 16 weeks, the length of BF sessions was not statistically significant different between fully breastfed infants (median: 10 minutes/feed; IQR: 6-20 minutes/feed; the range: 1-180 minutes/feed) and those receiving formula as well as breastmilk (median: 10 minutes/feed; IQR: 10-20 minutes/feed; the range: 5-50 minutes/feed). From 20 to 48 weeks, the length of most BF sessions (regarding of BF types) was shorter, compared to most BF sessions during previous weeks. The median remained at about ten minutes/feed, but the range was still wide, most feeds were between 1-40 minutes the rage of BF sessions remained wide, and most feeds were between 1-40 minutes and median remained (Figure 4.4, Figure 4.5 & Table 4.6).

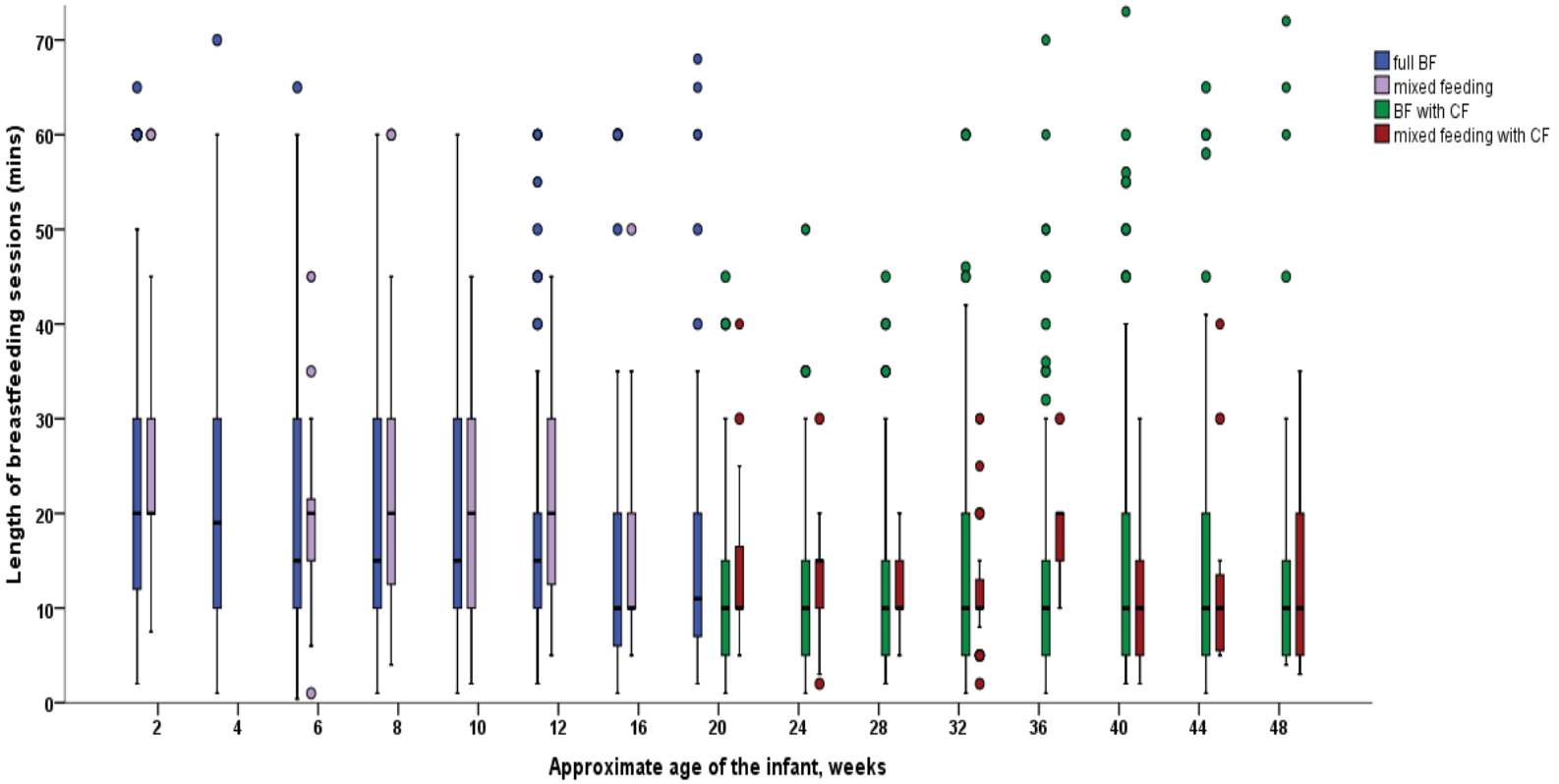


Figure 4.4. The length of breastfeeding sessions among different feeding types during 12 months (Median, 25th and 75th percentiles) (excluding breastfeeds longer than 70 minutes; excluding groups with less than 5 participants)

Note: BF: breastfeeding; CF: complementary foods; Length of breastfeeding session was the time spent at the breast and not include expressed milk.

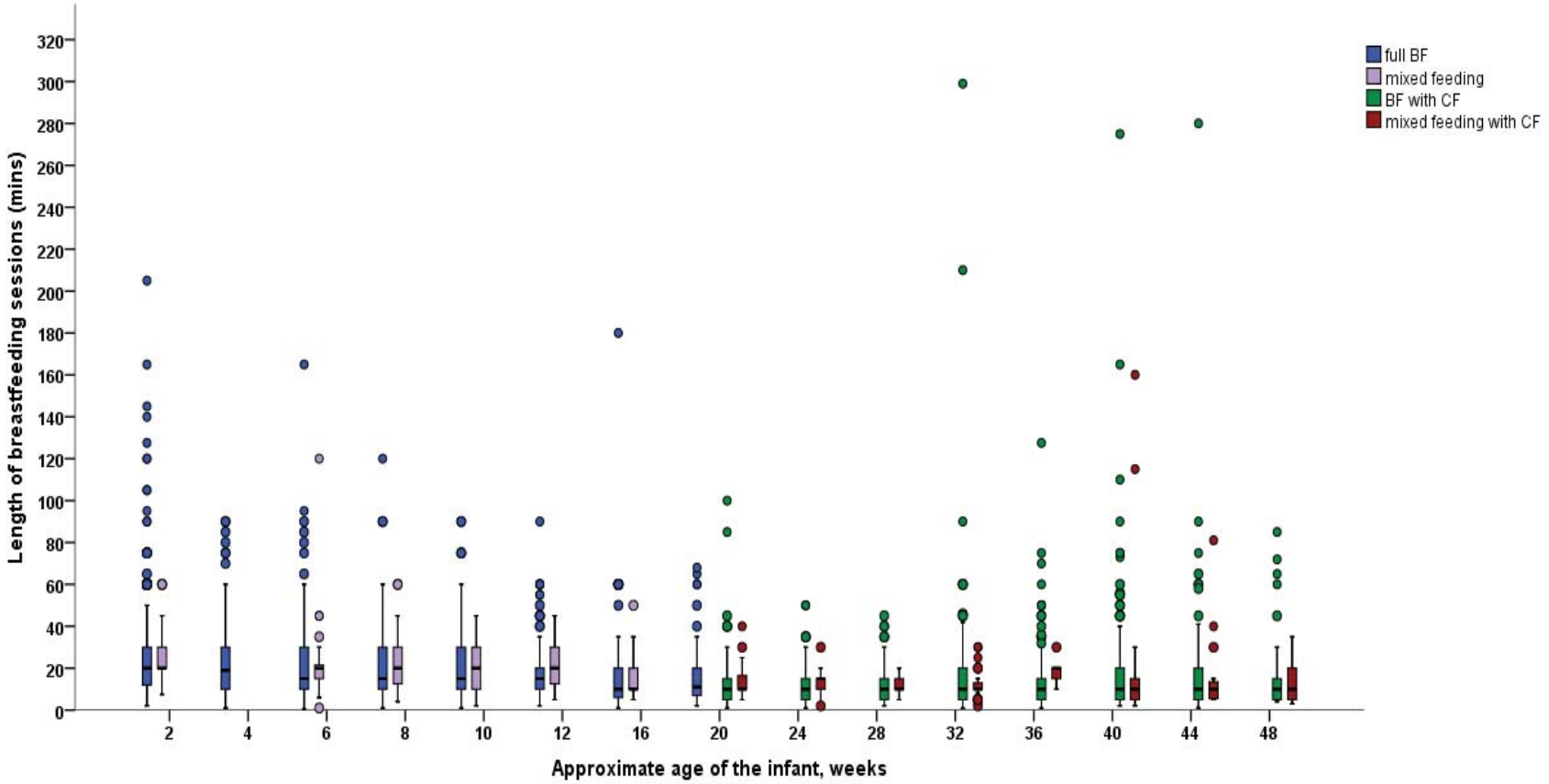


Figure 4.5. The length of breastfeeding session among different feeding types during 12 months including all observations (excluding the group less than 5 participants)

Note: BF: breastfeeding; CF: complementary foods; One BF session at 40 weeks of 690 minutes (owing to co-sleeping) was omitted.

Table 4.6. Length of breastfeeding session (minutes) among different feeding types during the first 12 months

Weeks	Feeding patterns	No. Breastfeeds (No. women)	Length of BF sessions (mins)		
			Percentiles		
			25	50 (median)	75
2*	Full BF[a]	444 (48)	12.00	20.00	30.00
	Mixed feeding[a]	33 (6)	20.00	20.00	30.00
	Total	477 (54)			
4	Full BF	487 (50)	10.00	19.00	30.00
	Mixed feeding×	21 (4)	10.00	20.00	37.50
	Total	509 (54)			
6*	Full BF[a]	434 (45)	10.00	15.00	30.00
	Mixed feeding[a]	28 (5)	15.00	20.00	21.75
	BF with CF×	9 (1)	30.00	45.00	60.00
	Total	471 (51)			
8*	Full BF[a]	425 (44)	10.00	15.00	30.00
	Mixed feeding[a]	36 (6)	11.25	20.00	30.00
	Total	461 (50)			
10*	Full BF[a]	398 (44)	10.00	15.00	30.00
	Mixed feeding[a]	37 (6)	10.00	20.00	30.00
	Total	435 (50)			
12*	Full BF[a]	386 (43)	10.00	15.00	20.00
	Mixed feeding[b]	28 (5)	11.25	20.00	30.00
	Total	414 (48)			
16*	Full BF[a]	343 (36)	6.00	10.00	20.00
	Mixed feeding[a]	32 (5)	10.00	10.00	20.00
	Mixed feeding with CF×	8 (1)	17.50	17.50	23.75
	BF with CF×	40 (4)	10.00	15.00	20.00
	Total	423 (46)			
20#	Full BF[a]	201 (22)	7.00	11.00	20.00
	Mixed feeding×	12 (2)	15.00	15.00	20.00
	Mixed feeding with CF[a]	27 (6)	10.00	10.00	18.00
	BF with CF[a]	121 (16)	5.00	10.00	15.00
	Total	361 (46)			
24*	Full BF×	34 (4)	5.00	10.00	15.00
	Mixed feeding with CF[a]	30 (8)	10.00	15.00	15.25
	BF with CF[b]	261 (33)	5.00	10.00	15.00
	Total	325 (45)			

Weeks	Feeding patterns	No. Breastfeeds (No. women)	Length of BF sessions (mins)		
			Percentiles		
			25	50 (median)	75
28*	Full BF×	33 (3)	5.00	10.00	25.00
	Mixed feeding with CF[a]	36 (7)	10.00	10.00	15.00
	BF with CF[a]	231 (32)	5.00	10.00	15.00
	Total	300 (42)			
32*	Full BF×	22 (1)	5.00	10.00	10.00
	Mixed feeding with CF[a]	42 (7)	10.00	10.00	13.00
	BF with CF[a]	223 (33)	5.00	10.00	20.00
	Total	287 (41)			
36*	Mixed feeding with CF[a]	13 (5)	12.50	20.00	20.00
	BF with CF[b]	200 (32)	5.00	10.00	15.00
	Total	213 (37)			
40*	Mixed feeding with CF[a]	25 (5)	5.00	10.00	15.00
	BF with CF[a]	191 (29)	5.00	10.00	20.00
	Total	216 (34)			
44*	Mixed feeding with CF[a]	15 (6)	5.00	10.00	15.00
	BF with CF[a]	170 (27)	5.00	10.00	20.00
	Total	185 (33)			
48*	Mixed feeding with CF[a]	19 (6)	5.00	10.00	20.00
	BF with CF[a]	138 (22)	5.00	10.00	15.00
	Total	157 (28)			

Note: BF: breastfeeding; CF: complementary foods

[*]Mann-Whitney Test; [#]Kruskal Wallis Test;

a-b feeding patterns in a column followed by different superscripts are significantly different in mean rank at the significant level of $P< 0.05$.

× feeding patterns in a column not include in analysis (less than 5 participants);

Note: length of breastfeeding session was the time spent at the breast and not include expressed milk.

4.2.4.2 Distributions of the length of breastfeeding sessions at 2, 4, 24 and 48 weeks

As shown in Figures4.6-4.9, the length of BF sessions reduced over time. Specifically, for fully BF infants at two weeks about 80% of BF sessions were less than 40 minutes, with 24% less than ten minutes and about 20% between 11-19 minutes, 20-29 minutes and 30-39 minutes. About 10% of BF sessions were more than one hour (Figure 4.6). At four weeks slightly more than 30% BF sessions lasted ≤10 minutes. About 55% BF sessions were less than 40 minutes, while there were still about 10% BF sessions more than one hour (Figure 4.7). At 24 weeks, more than half of the BF sessions for fully BF infants (n=4) were ten minutes or less (Figure 4.8).

For mixed-fed infants, at two weeks about 55% breastfeeds lasted 20-29 minutes, with approximately 10% lasting 10-20 min, 15% lasting 30-39 min, and a further 10% >1 hour (Figure 4.6). At four weeks, 38% BF sessions were ≤10 minutes. Most of the remaining BF sessions for mixed-fed infants were between 20-29 minutes or between 40-49 minutes at four weeks. While there were still about 8% BF sessions longer than one hour at four weeks (Figure 4.7).

By 24 weeks the majority of infants were receiving CF. For mixed feeding infants receiving CF at 24 weeks, more than 80% of BF sessions were less than 20 minutes (Figure 4.8). At 48 weeks, most breastfeeds (approximate 60%) were ≤10 minutes (Figure 4.9).

For BF infants received CF, about three quarters were 10 minutes or less at 24 and 48 weeks (Figure 4.8 & Figure 4.9). However, there was still a small percentage of breastfeeds (3%) which lasted more than 1 hour at 48 weeks (Figure 4.9).

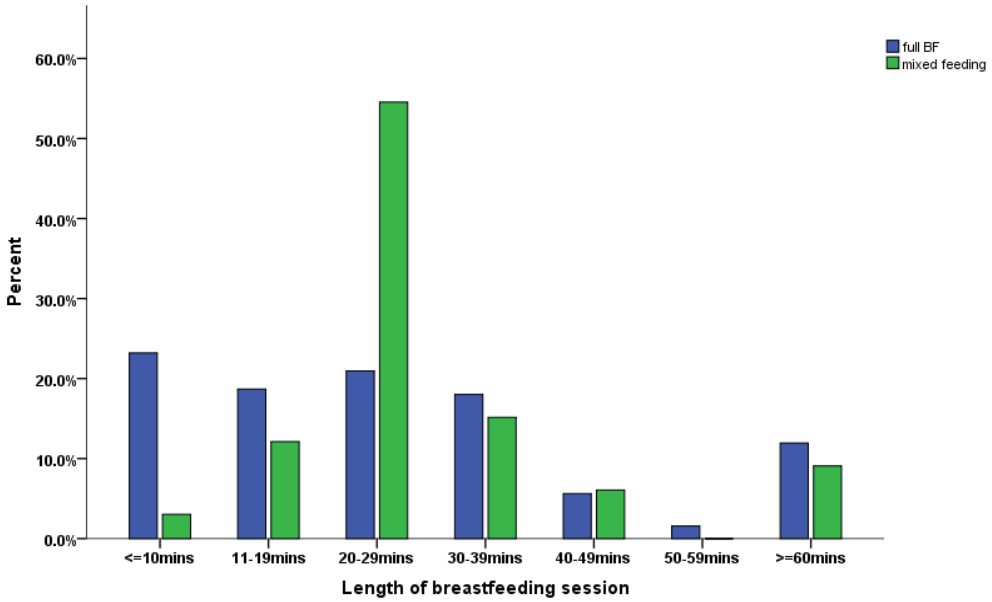


Figure 4.6. Length of breastfeeding session at two weeks of infants' age

Note: BF: breastfeeding; CF: complementary foods;

Full BF: No.= 48 women (444 breast sessions); Mixed feeding: No.= 6 women (33 breast sessions).

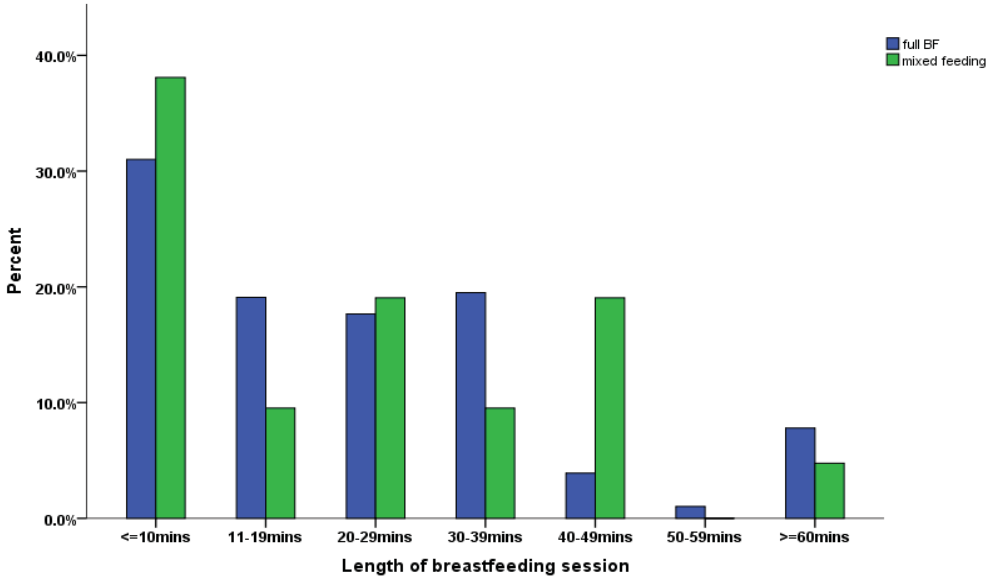


Figure 4.7. Length of breastfeeding session at four weeks of infants' age

Note: BF: breastfeeding; CF: complementary foods;

Full BF: No.= 50 women (487 breastfeeding sessions); Mixed feeding: No.= 4 women (21 breast sessions).

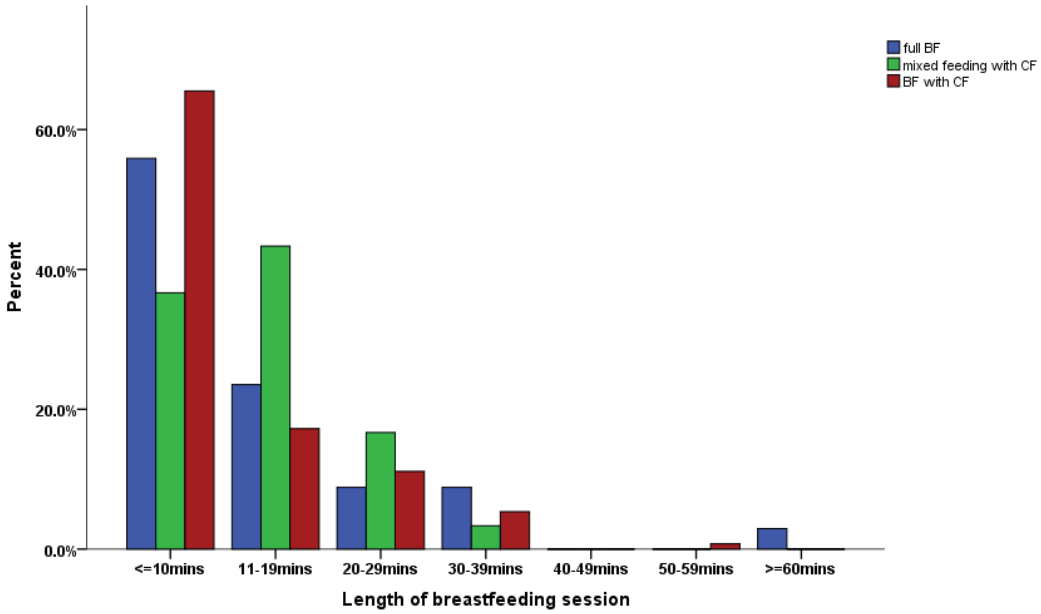


Figure 4.8. Length of breastfeeding session at 24 weeks of infants' age

Note: BF: breastfeeding; CF: complementary foods;

Full BF: No.= 4 women (34 breast sessions); Mixed feeding with CF: No.= 8 women (30 breast sessions); BF with CF: No.= 33 women (261 breast sessions).

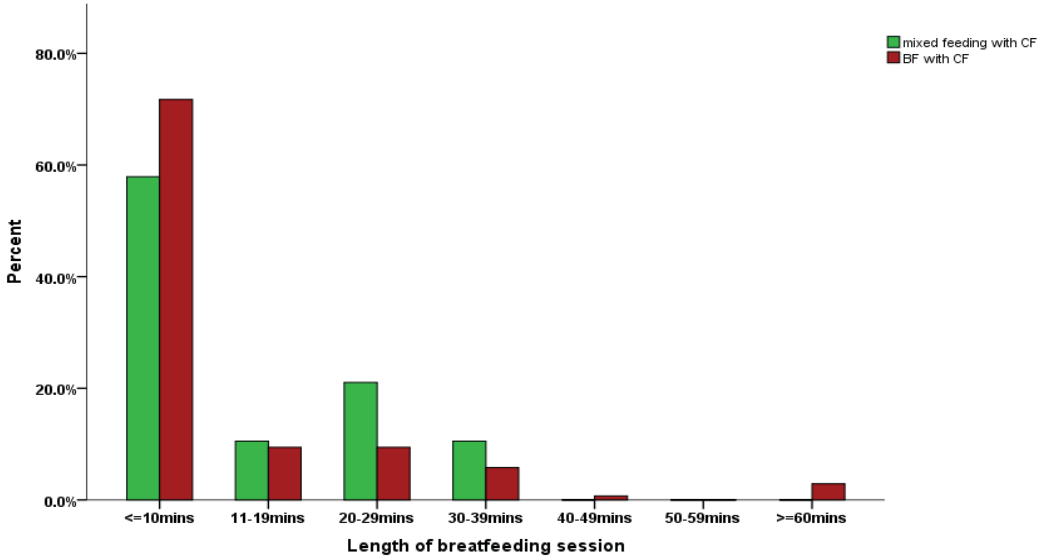


Figure 4.9. Length of breastfeeding session per day at 48 weeks of infants' age

Note: BF: breastfeeding; CF: complementary foods;

Mixed feeding with CF: No.= 6 women (19 breast sessions); BF with CF: No.= 22 women (138 breast sessions).

4.3 Breastfeeding frequency and duration

4.3.1 The association between breastfeeding frequency and breastfeeding duration

No correlation was found between the duration of full BF and BF frequency/day of at two weeks and at four weeks. However, duration of any BF was significantly and positively and week correlated with BF frequency/day at two weeks (P<0.01; r=0.352) and four weeks (P<0.01; r=0.404). Duration of BF was also had a significant and positive association with frequency/day for fully BF infants at four weeks (P<0.05; r=0.298) (Figure 4.7).

Table 4.7. Correlation between BF frequency and BF duration

Correlations

			BF Frequency		**BF Frequency, among full BF only**	
			at 2wk	**at 4wk**	**at 2wk**	**at 4wk**
Spearman's rho	**Full BF duration**	Correlation Coefficient	0.239	0.074	0.250	0.066
		Sig. (2-tailed)	0.094	0.604	0.086	0.650
		N	50	51	48	50
	BF duration	Correlation Coefficient	0.352	0.404	0.187	0.289
		Sig. (2-tailed)	0.008	0.002	0.204	0.042
		N	55	55	48	50

4.4 Association of breastfeeding duration with maternal and infant characteristics

Full BF duration was not statistically associated with maternal characteristics such as age, levels of education, and ethnicity and infants' gender (Figure 4.8). Total BF duration was also not associated with maternal and infant characteristics, with the exception of a positive association with parity of two or more (Figure 4.9).

Table 4.8. Maternal characteristics and full-BF duration

Characteristic	NO. (total n=51)	Full breastfeeding duration (wks)		
		Percentiles		
		25	50 (median)	75
Maternal age[#] (Y)				
21-24[a]	6	10.00	14.00	30.00
25-29[a]	6	16.00	18.00	21.00
30-34 [a]	23	12.00	16.00	20.00
≥35 [a]	16	16.00	18.00	20.00
Maternal ethnicity[*]				
NZ European[a]	43	12.00	16.00	20.00
NZ Maori& others[a]	8	12.00	18.00	23.00
Maternal education[*]				
<Bachelor[a]	28	13.00	16.00	20.00
≥Bachelor[a]	23	12.00	16.00	20.00
Parity[#] (No.)				
0[a]	19	11.50	16.00	21.00
1[a]	26	12.00	16.00	20.00
≥2[a]	14	16.00	16.00	20.00
Mode of delivery[*]				
Natural[a]	40	12.00	16.00	20.00
Cesarean[a]	11	16.00	20.00	20.00
No. children living with[#]				
0[a]	15	12.00	16.00	20.00
1[a]	23	12.00	16.00	20.00
≥2[a]	13	16.00	16.00	20.00

Characteristic	NO. (total n=51)	Full breastfeeding duration (wks)		
		Percentiles		
		25	50 (median)	75
Living with partner[*]				
No[a]	6	13.00	22.00	27.00
Yes[a]	45	12.00	16.00	20.00
Past breastfeeding experience[#] (N= 48)				
No breastfed experience[a]	14	11.50	16.00	21.00
Breastfed < 6 mons[a] (longest duration)	13	9.00	16.00	18.00
Breastfed ≥6 mons[a] (longest duration)	21	16.00	20.00	20.00
Infant gender[*]				
Female[a]	22	15.00	20.00	20.00
Male[a]	29	12.00	16.00	20.00

[*]Mann-Whitney Test; [#]Kruskal Wallis Test;

a-b median values in a column followed by different superscripts are significantly different in mean rank at the significant level of P< 0.05.

Table 4.9. Maternal characteristics and breastfeeding duration

Characteristic	NO. (total n=59)	Any breastfeeding duration (wks)		
		Percentiles		
		25	50 (median)	75
Maternal age[#] *(Y)*				
21-24[a]	7	6.00	40.00	48.00
25-29[a]	6	37.00	46.00	48.00
30-34[a]	28	21.00	40.00	48.00
≥35[a]	18	36.00	48.00	48.00
*Maternal ethnicity**				
NZ European[a]	51	20.00	44.00	48.00
NZ Maori& others[a]	8	34.00	46.00	48.00
Maternal education[*]				
<Bachelor[a]	32	17.00	44.00	48.00
≥Bachelor[a]	27	28.00	44.00	48.00

Characteristic	NO. (total n=59)	Any breastfeeding duration (wks)		
		Percentiles		
		25	50 (median)	75
Parity(No.)[#]				
0[a]	19	20.00	36.00	48.00
1[ab]	26	15.00	44.00	48.00
≥2[b]	14	47.00	48.00	48.00
Mode of delivery[*]				
Natural[a]	44	26.00	44.00	48.00
Cesarean[a]	15	12.00	48.00	48.00
No. children living with[#]				
0[a]	20	20.00	38.00	48.00
1[a]	26	15.00	44.00	48.00
≥2[a]	13	46.00	48.00	48.00
Living with partner[*]				
No[a]	6	13.50	48.00	48.00
Yes[a]	53	24.00	44.00	48.00
Past breastfeeding experience[#] *(N=55)*				
No breastfed experience[a]	19	20.00	36.00	48.00
Breastfed < 6 mons[a] (longest duration)	15	12.00	44.00	48.00
Breastfed ≥6 mons[a] (longest duration)	21	44.00	48.00	48.00
Infant gender[*]				
Female[a]	26	27.00	48.00	48.00
Male[a]	33	20.00	44.00	48.00

[*]Mann-Whitney Test; [#]Kruskal Wallis Test;

a-b median values in a column followed by different superscripts are significantly different in mean rank at the significant level of P< 0.05.

4.5 Case study— respondents breastfed infants till 48 weeks

BF behaviours of four participants who breastfed their babies till 48 weeks were examined. Two of them had less than eight breastfeeds/day at two or four weeks postpartum; the other two participants reported at least 16 breastfeeds/day at two or four weeks postpartum. A wide variability of BF practices was observed during the first year after birth, which may be the result of the diverse characteristics of personal BF styles and the interaction of infants and mothers. BF practices were also reported to be influenced by other factors including infants and maternal health status, fussy periods, home and outside environments, opinions from people and organizations such as the Plunket Society.

4.5.1 Cases with lower BF frequency during the first four weeks postpartum

The respondent AO first breastfed her infant within ten minutes after delivery. She said she was demand-breastfeeding. At two weeks she fed the baby seven times/day, the longest interval between BF was five hours and total length of BF sessions/day was nine hours. The BF sessions varied between 60-75 minutes. From 2-10 weeks BF frequency varied between 6-9 times/day, the longest intervals between BF generally ranged from 4.5-6 hours, with the exception — nine hours at six weeks, when AO said the baby "doesn't usually sleep for that long without waking". During this period the total length of BF sessions per day went from nine hours at two weeks down to three hours at ten weeks. BF sessions varied greatly (15-90

minutes), but there was a trend towards greater proportion of shorter feeds (Figure 4.10).

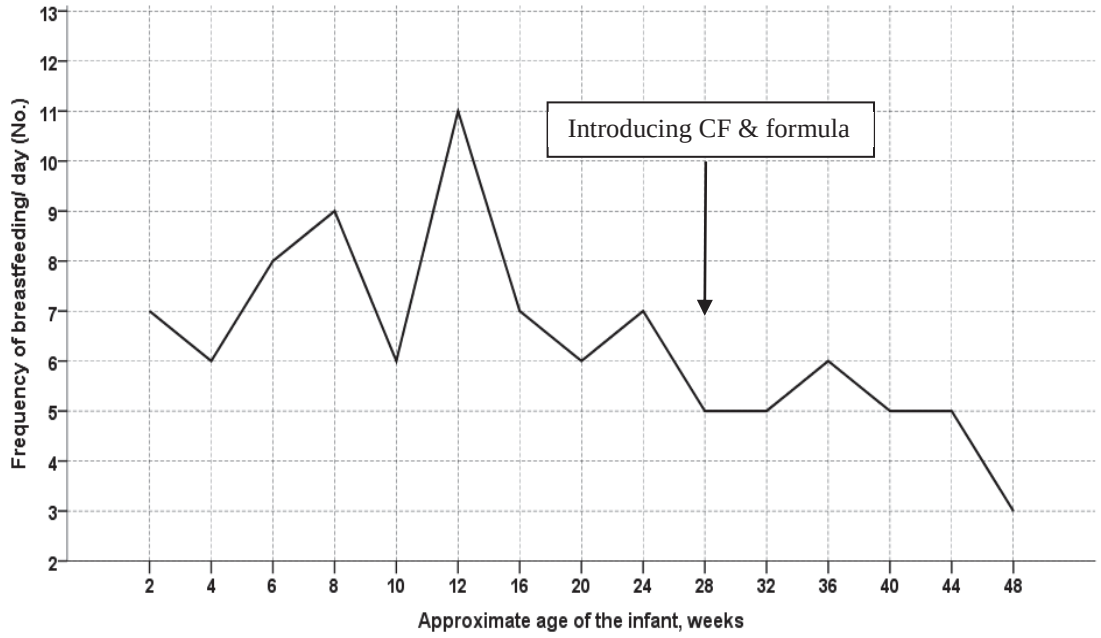
At 12 weeks, the baby was fed 11 times/day, in which most BF sessions ranged between 10-23 minutes with median 20 minutes (but having several extraordinary longer BF sessions — more than 100 minutes). The mother said "the baby was more unsettled and feeding more than usual", but total length of BF sessions was similar to that reported at ten weeks when the infant received six breastfeeds/day. From 16-24 weeks the baby was fed 6-7 times/day, the longest interval between BF gradually increased from 6 to 9.5 hours, total length of BF sessions/day decreased from 3.4 to 1.4 hours. Moreover, BF sessions at 16 weeks ranged from 20-35 minutes and one BF session of 60 minutes, and then down to 5-15 minutes (range) at 24 weeks (Figure 4.10).

At 28 weeks, CF and formula were introduced to the infant. Between 28-44 weeks, the baby had 5-6 breastfeeds/day, and the longest interval between BF was between 3.8-8.5 hours. BF sessions ranged between 5-15 minutes, and the total length of BF sessions/day dropped to about 0.5 hours. At 48 weeks, she breastfed three times/day, mostly at night, and "one in the afternoon" with formula given during the in daytime. The longest interval between BF was about 11 hours, and each BF session was no more than five minutes, with a total of 13 minutes in the 24 hours (Figure 4.10).

Concerning BF sessions, the variation and length decreased after the first ten weeks. The total length of BF sessions/day generally declined (from nine hours at two weeks to less than one hour at 48 weeks), which may be owing to "more efficiently and quickly breastfeeding" the mother explained. The longest interval between BF fluctuated, but remained more than six hours/day from 32-48 weeks (Figure 4.10).

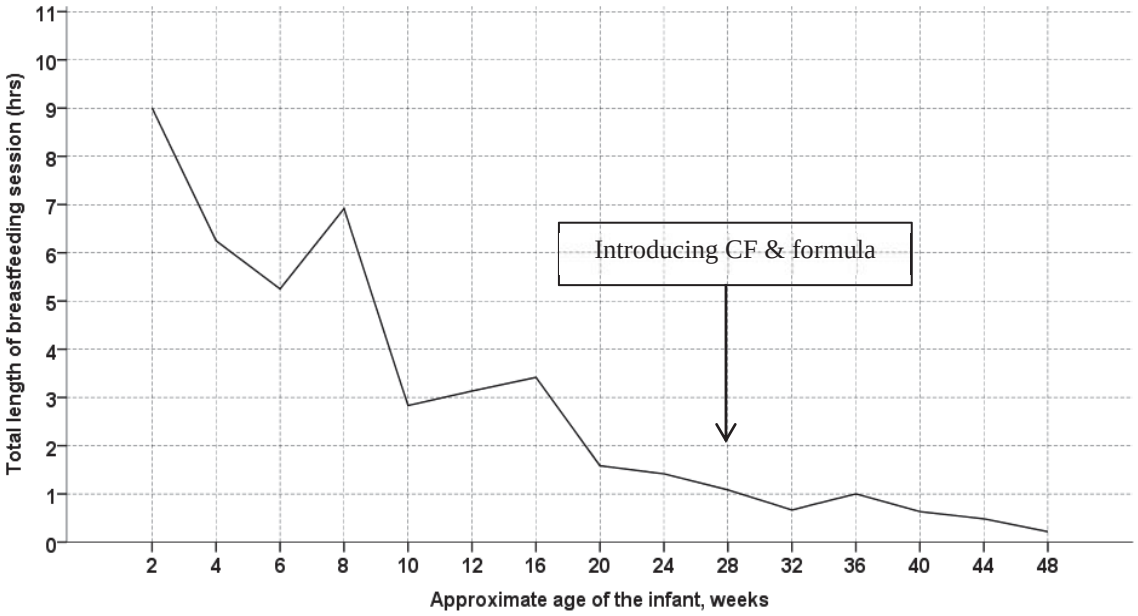
During the observed time frame, AO said she was following advice from the Plunket nurse to feed the baby every 3-4 hours and introduce solid foods in the 6th month. She also mentioned several factors which had an influence on BF frequency including a latching problem, sick baby, and unexplained unsettled condition of the infant. She was said that "when the infant got sick, which put everything out of wack". AO generally thought she breastfed successfully and believed BF was important.

A: Respondent AO: Breastfeeding frequency per day during the first 12 months postpartum



B: Respondent AO: Longest interval between breastfeeds per day during the first 12 months postpartum

C: Respondent AO: Total length of breastfeeding sessions per day during the first 12 months postpartum



D: Respondent AO: Length of each breastfeeding session per day during the first 12 months postpartum

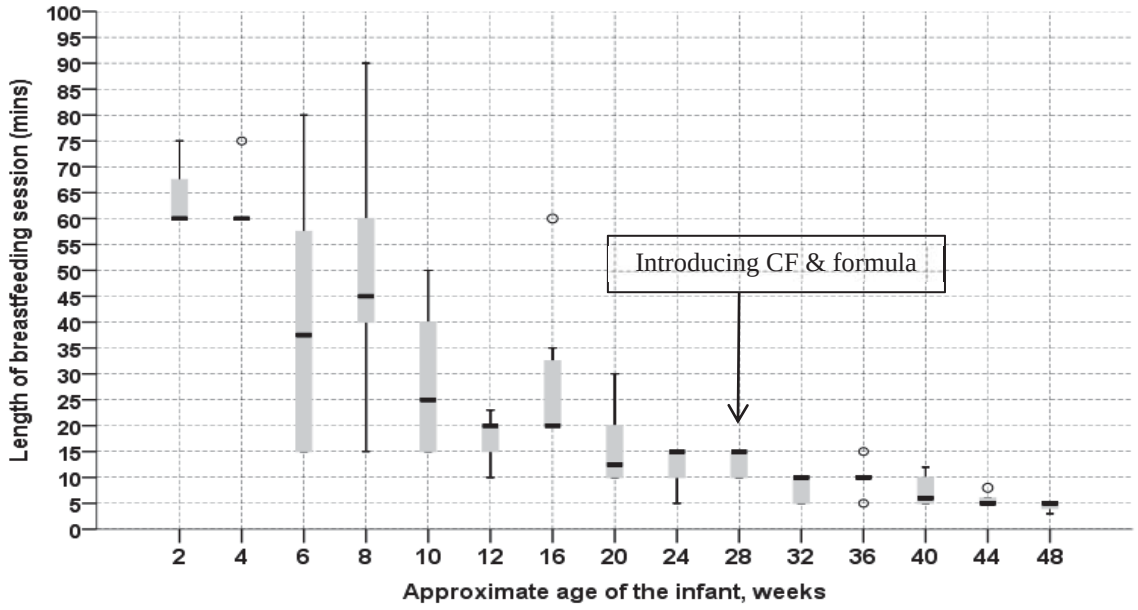


Figure 4.10. Breastfeeding practices for the respondent AO who has low BF frequency at four weeks. A: breastfeeding frequency; B: longest interval between breastfeeds; C: total length of breastfeeding sessions; D: length of each breastfeeding session.

Note: One BF session at 2 weeks of 165 minutes (owing to co-sleeping) was omitted.

The respondent BG first breastfed her baby within 40 minutes after delivery and breastfed on-demand. At two weeks she breastfed the baby six times/day, the longest interval between BF was 5.5 hours, and BF sessions ranged between 20-30 minutes with total in 24 hours of 2.7 hours. From two to six weeks the number of BF dramatically increased from 6-16 times/day, according to the mother's report this may be owing to "he was having problems with bowel motions and wind" and "he was more irritable than normal, and more irritable after doing spits". The longest interval between BF remained between 4.3-5.5 hours, the total length of BF sessions/day was between 2.3-4.3 hours, and the median BF sessions decreased from 30-5 minutes (Figure 4.11).

From 6-12 weeks, the baby was breastfed less frequently from 16-7 feeds/day, the total length of BF sessions/day declined between 3.1-1.1 hours, and the median BF sessions was between 5-15 minutes (range between 2-25 minutes). The longest interval between BF increased from 3.7-8.6 hours. The mother reported at 10 weeks "he does not normally sleep as long at night as he did, and has been a lot better in his wind and bowel motions since going to the osteopath", and said at 12 weeks "more unsettled than normal because were travelling in the car and ferry" (Figure 4.11).

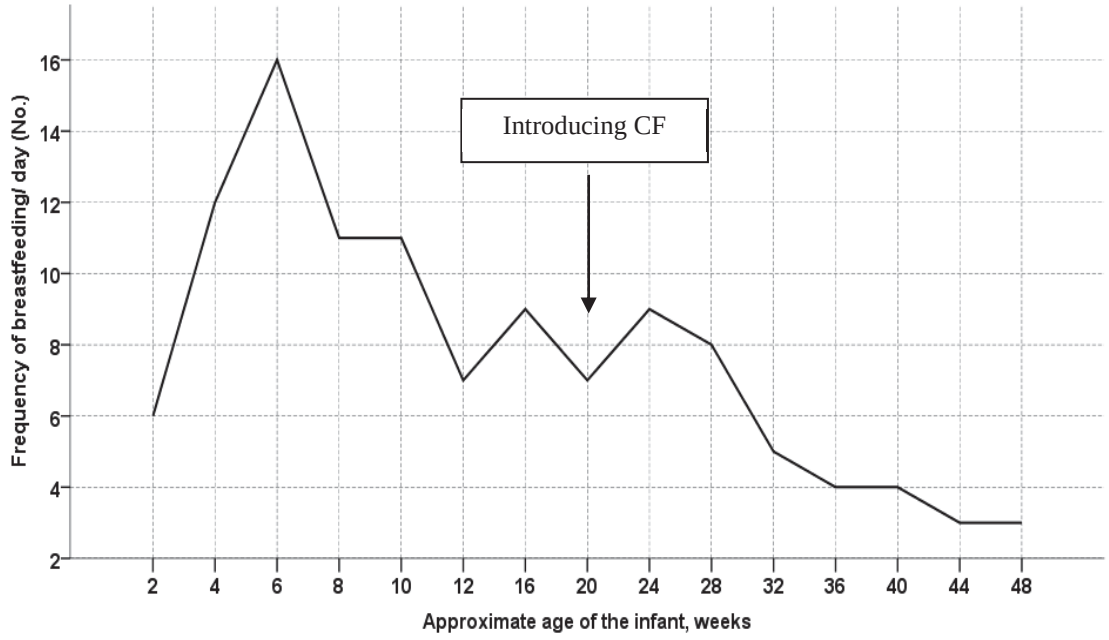
At 20 weeks, the infant was given CF in addition to BF. Between 16-24 weeks, breastfeeds remained between 7-9 times/day, while the longest interval between BF declined from 8.6-5.5 hours, and the total length of BF sessions/day slightly decreased from 2.8-2 hours. The median BF sessions decreased from 20-25 minutes at 16-20 weeks to 15 minutes at 24 weeks. From 28-48 weeks, BF frequency/day decreased from 8-3 times/day, the total length of BF sessions in 24 hours was decreased from 1.7-0.5 hours, and the median BF sessions was between 12.5-7

minutes (range 3-40 minutes), and the longest interval between BF varied between 9.3-13.8 hours. BG reported "breastfeeds getting less and quantity of solids increased" (Figure 4.11).

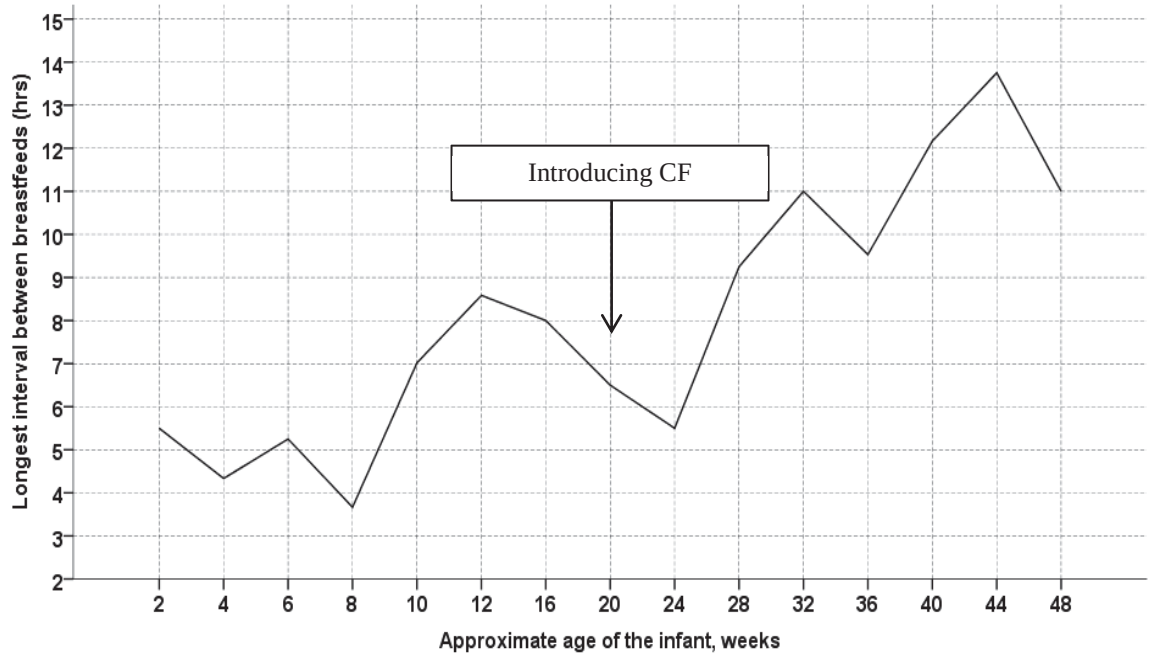
Overall, the longest interval between BF generally increased during the 48 weeks postpartum. BF frequency/day and the total length of BF sessions/day decreased with time, and BF sessions with most observations ≤30 minutes (Figure 4.11).

During the first 12 months, based on the mother's reports, it seems that the baby struggled with problems of bowel motions and wind, which made "the baby irritable and distracted". Additionally, unsettled conditions and increasing feeding solids were other factors to have an effect on BF frequency. However, BG generally reported that she breastfed the baby successfully and thought BF was important.

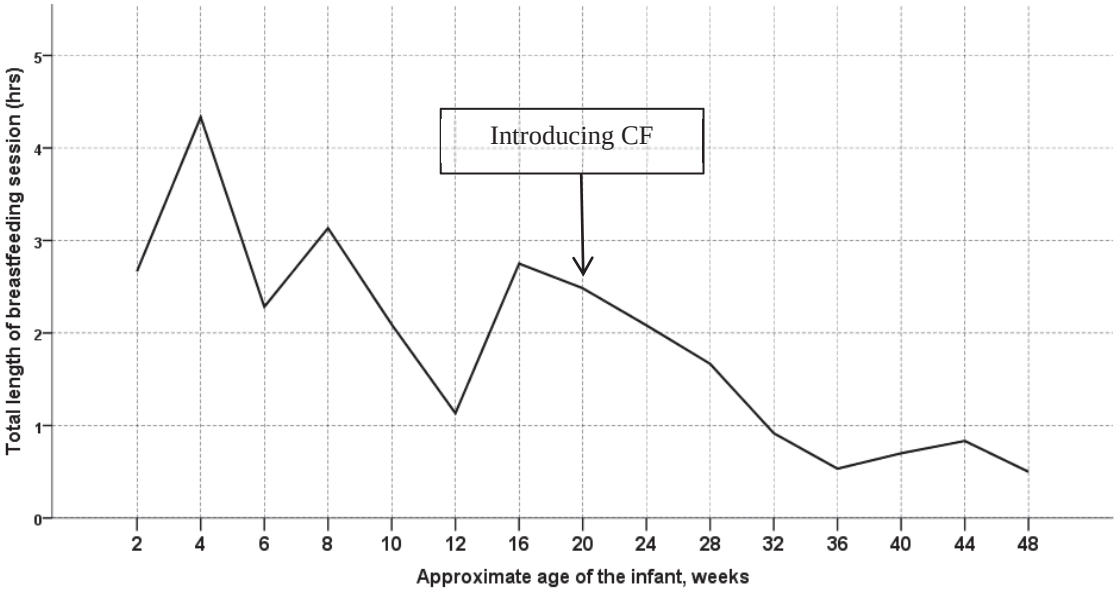
A: Respondent BG: Breastfeeding frequency per day during the first 12 months postpartum



B: Respondent BG: Longest interval between breastfeeds per day during the first 12 months postpartum



C: Respondent BG: Total length of breastfeeding sessions per day during the first 12 months postpartum



D: Respondent BG: Length of each breastfeeding session per day during the first 12 months postpartum

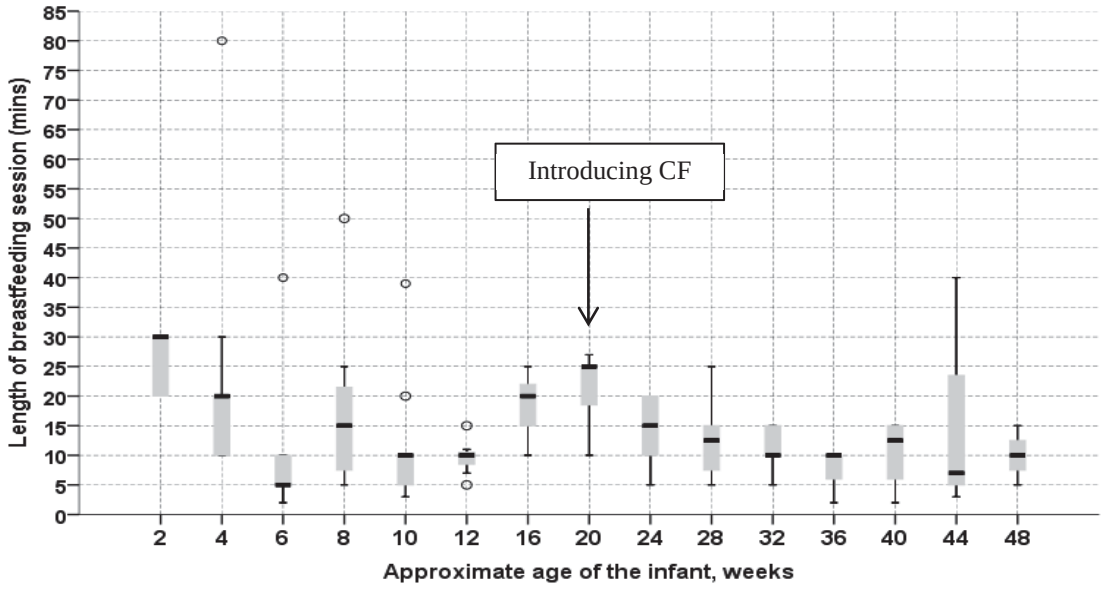


Figure 4.11. Breastfeeding practices for the respondent BG who has low BF frequency at two weeks. A: breastfeeding frequency; B: longest interval between breastfeeds; C: total length of breastfeeding sessions; D: length of each breastfeeding session.

4.5.2 Cases with higher BF frequency during the first four weeks postpartum

The participant BA initiated BF within one hour after birth. She reported that she breastfed the baby on demand. At two weeks she breastfed the baby 17 time/day, the longest interval between BF was 4.5 hours/day and the total length of BF sessions/day was 4.3 hours/day. BF sessions ranged between 5-20 minutes (median 13.5 minutes). From 2-10 weeks the number of BF/day was between 15-21 times/day, the longest interval between BF generally increased from 4.5-6.1 hours/day, the mother said that the baby's sleeping patterns changed from "awake more during the day time, a little less often at night" to "often sleeping for 5-6 hours". The total length of BF sessions/day was 5.1 hours at 6 weeks and had reduced to 2.8 hours. The median BF sessions nearly remained around 10 minutes (range between 2-25 minutes) (Figure 4.12).

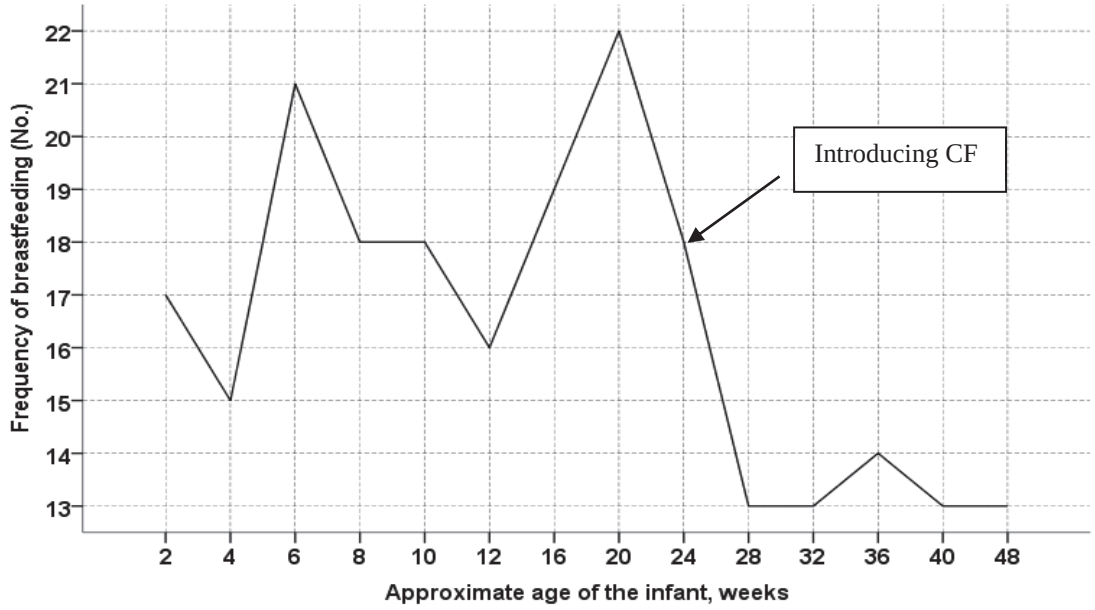
At 12 weeks, BA breastfed the baby 16 times/day, the longest interval between BF was seven hours/day, and the total length of BF sessions/day was 2.2 hours/day, and median BF sessions in 24 hours was eight minutes and ranged between 2.5-15 minutes. The mother reported that the baby's feeding and sleeping was normal, "starting sleeping through the night sometimes and maybe a little quicker in feeding", and also she had a good feeling for feeding the baby. Compared to BF practices at 12 weeks, between 16-24 weeks, the overall numbers of breastfeeds increased (between 18-22 times/day), while the longest interval between BF remained similar (between 3.3-3.6 hours/day) as did the total length of BF sessions/day (between 2.5-3.3 hours/day). The BF sessions tended to be shorter (ranged 1-15.5 minutes, median 5-7.5 minutes). At 16 weeks, the mother said "she started waking at 12AM.,

wanted to feed every hour till six AM., and breastfed a bit shorter during the day time". At 24 weeks, the infant was given CF, and BF was different, the mother said "sleeping were worse than normal— woke more in the night, had more feeds" (Figure 4.12).

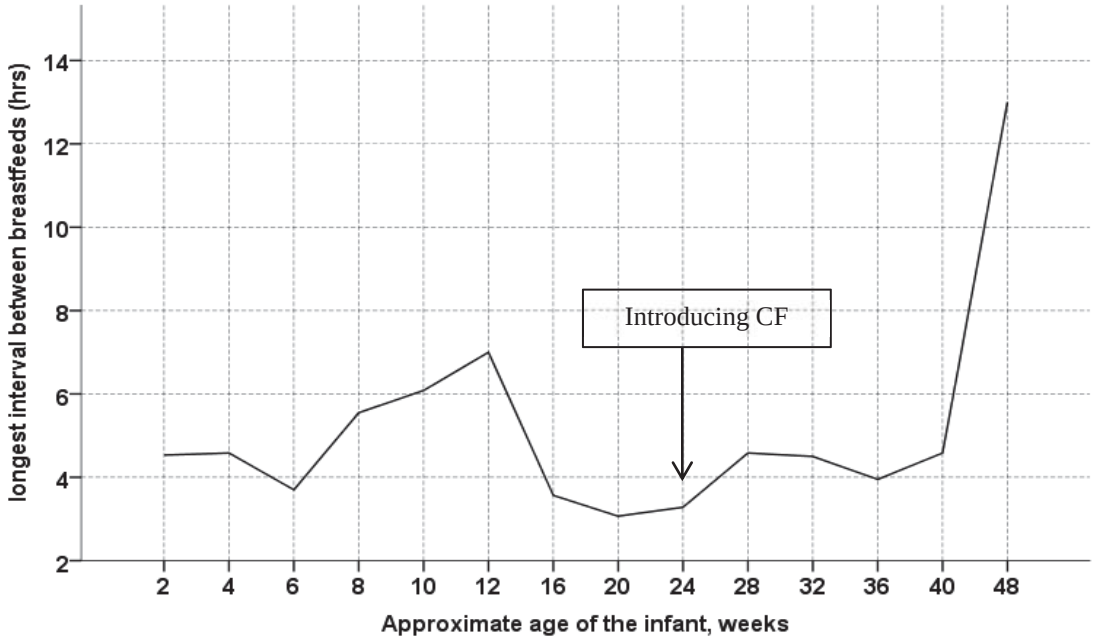
From 28-48 weeks, the number of breastfeeds remained stable between 13-14 times/day which was less frequent than before. The total length of BF sessions/day was 1.5-2.3 hours/day and median BF sessions was five minutes (range 2-15 minutes) at 40 weeks. There was an unusual case — 14.3 hours/day of the total length of BF sessions/day and 40 minutes median BF sessions (range 7-75 minutes). The longest interval between BF remained between 4-4.6 hours/day. At 48 weeks the longest interval between BF was 13 hours/day (Figure 4.12).

All in all, BA breastfed the baby at least 13 times/day throughout the period of the first 48 weeks whenever she perceived the baby needed a BF. At 16 weeks she reported that she felt exhausted especially for the night feeds, but she said she had to feed the baby, because she did not want to get the baby upset and leave the baby to cry. During the first 36 weeks, BF sessions ranged 1-25 minutes, and the longest interval between BF did not tend to increase and fluctuated between 3-7 hours (Figure 4.12). Generally, BA felt BF was important and she did successfully.

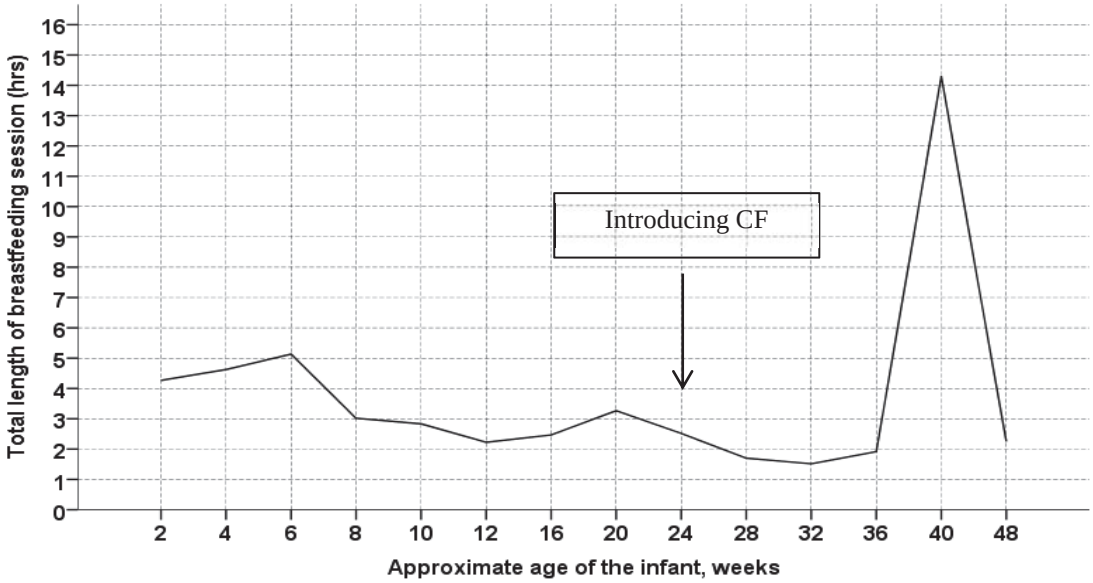
A: Respondent BA: Breastfeeding frequency per day during the first 12 months postpartum



B: Respondent BA: Longest interval between breastfeeds per day during the first 12 months postpartum



C: Respondent BA: Total length of breastfeeding sessions per day during the first 12 months postpartum



D: Respondent BA: Length of each breastfeeding session per day during the first 12 months postpartum

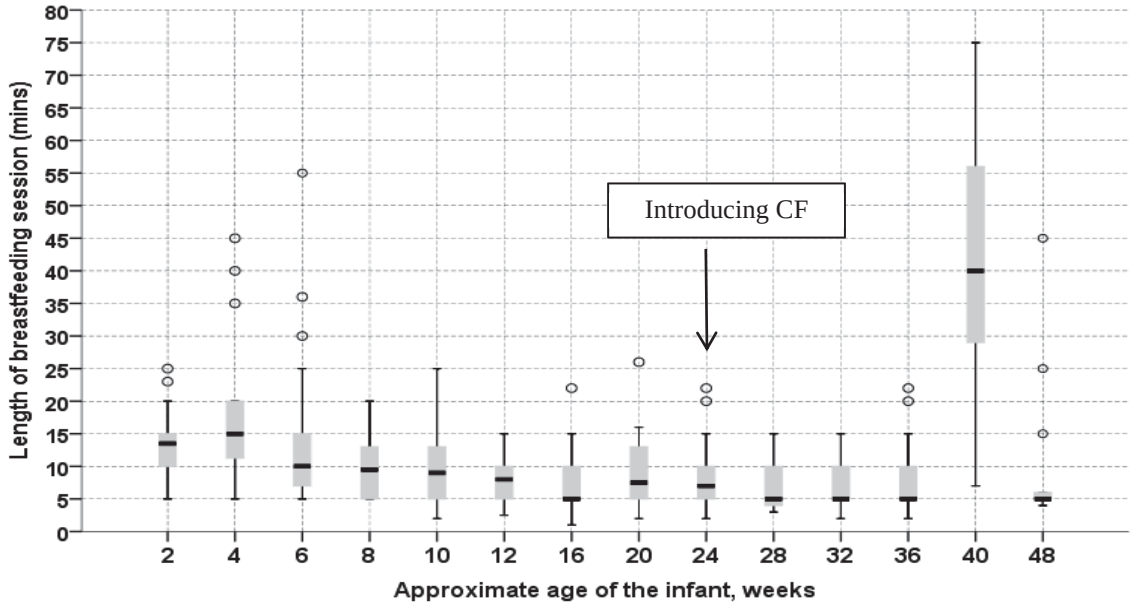


Figure 4.12. Breastfeeding practices for the respondent BA who has high BF frequency at two weeks. A: breastfeeding frequency; B: longest interval between breastfeeds; C: total length of breastfeeding sessions; D: length of each breastfeeding session.
Note**:** Two BF sessions at 40 weeks of 165 and 275minutes (owing to co-sleeping) were omitted.

The respondent BD first breastfed her baby about ten minutes after delivery. She said she was generally BF to a schedule. She said that during the first half year she BF roughly every 3-4 hours during the day, and 2-3 times at night when the baby woke. This pattern then changed to about four hourly breastfed during 24 hours, and finally at 48 weeks the infant only breastfed scarcely. At two weeks, she breastfed the baby ten times/day, the longest interval between BF was four hours/day, the total length of BF sessions/day was 3.8 hours/day and median BF sessions was 25 minutes, ranging from 10-45 minutes. And four and six weeks, the infant was breastfed from 16-14 times/day with short feeds (median about five minutes, with total 1.1-2.5 hours/day). The mother reported the infants was "more unsettled than usual in the evening". The longest interval between BF remained about 5.5 hours/day (Figure 4.13).

From 8-16 weeks, the number of breastfeeds declined from 14-11 times/day, the longest interval between BF ranged between 5.5-7.1 hours/day, and the total length of BF sessions/day dropped between 1-1.8 hours/day. The median BF sessions also remained at 5 minutes and ranged 2-8 minutes, with a relatively wide variation at eight weeks (1-20 minutes). The mother reported at eight weeks, "bigger stretches at night without needing a feed, went for 6.5 hours during the night", and "usually wakes once in the night". At 20 weeks, CF were introduced to the infant, and there was nearly no change in BF frequency (ten times/day), longest interval between BF (6.4 hours/day), total length of BF sessions/day (0.9 hours/day), and the median BF session (five minutes), compared to the prior eight weeks (Figure 4.13).

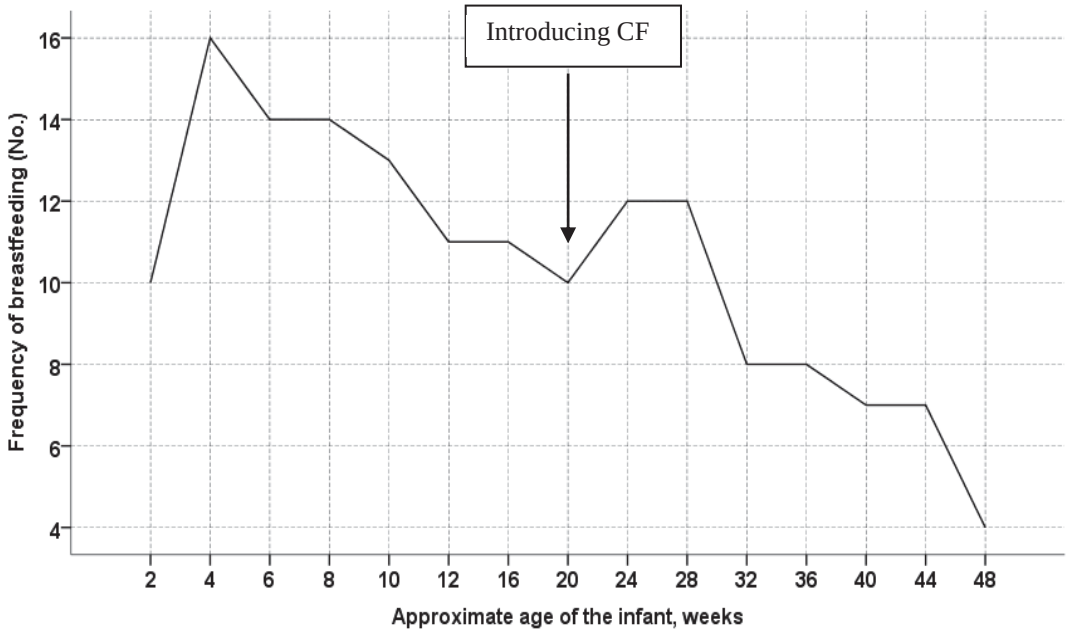
Between 24-28 weeks, BD breastfed the baby 12 times/day, she said "feed more frequently due to mastitis", while the longest interval between BF (6.5-6.7

hours/day), total length of BF sessions/day (1.1-1 hours/day), and median BF sessions (five minutes) remained similar as 20 weeks. From 32-48 weeks, the number of breastfeeds decreased from 8-4 times/day, the longest interval increased from 7.4-12.4 hours/day, but total length of BF sessions and the median BF sessions was hardly changed (Figure 4.13).

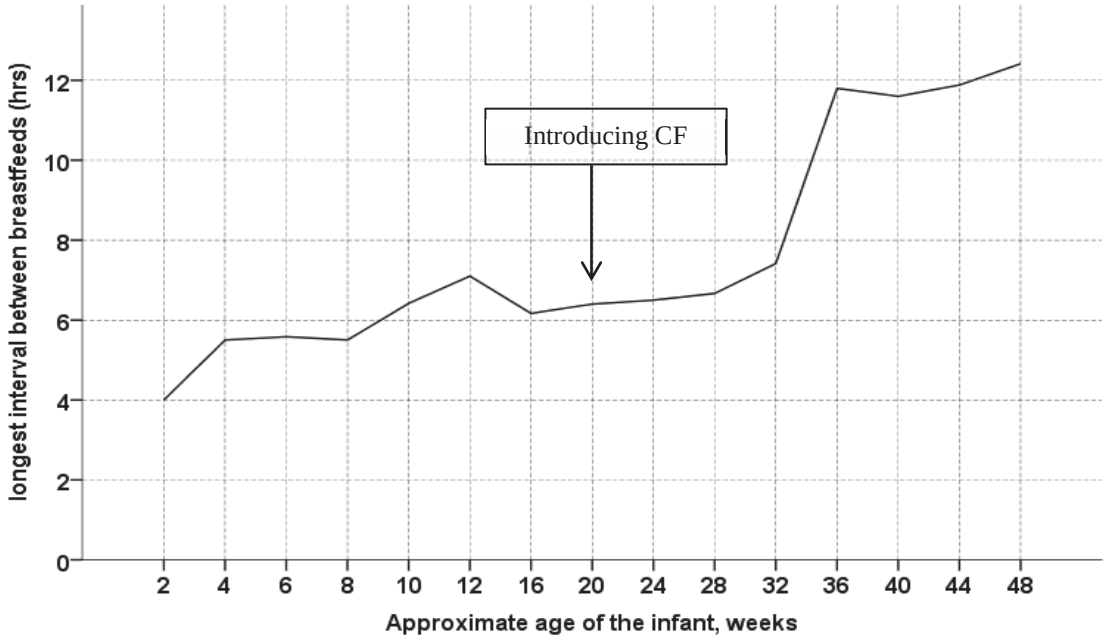
Throughout the observed period, the baby was breastfed frequently — at least eight times/day during the first 36 weeks, and normally had short BF sessions (majority of feeds less than ten minutes with median five minutes at the majority observations). The longest interval between BF increased from four hours to above 12 hours from 2-48 weeks (Figure 4.13).

This respondent reported BD breastfed the infant between 3-4 hours during the daytime, which remained during the period of about more than the first half year. Night-time breastfeeds were affected by sleeping patterns of the infant. She mentioned that she and her infant was sick and noisy family environment (due to friends staying), which may have an influence on BF practices as well. Overall, BD thought she breastfed successfully and BF was important.

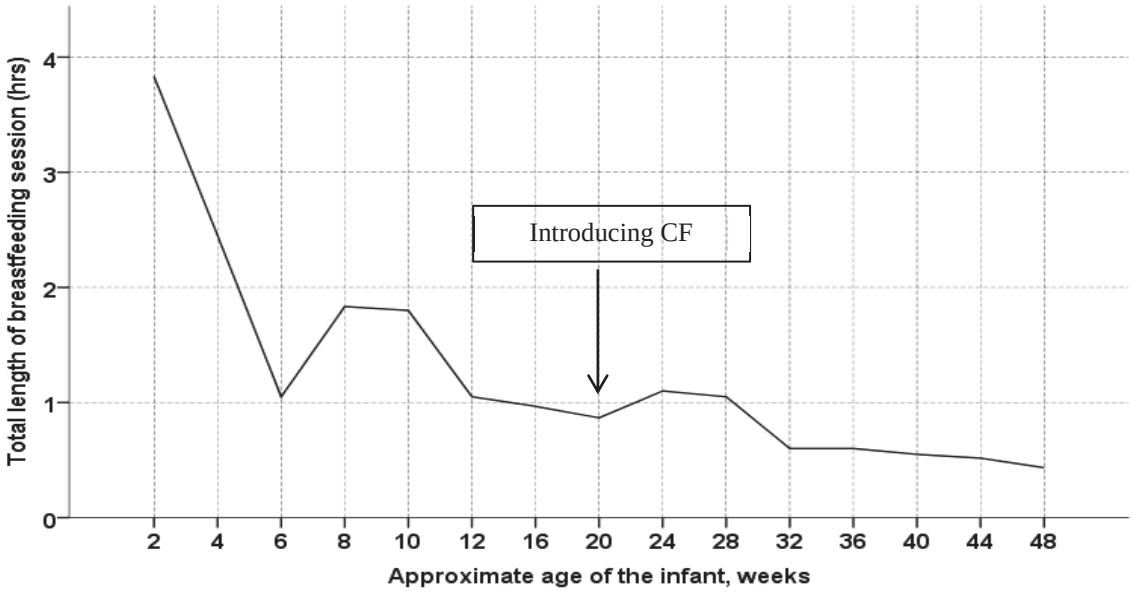
A: Respondent BD: Breastfeeding frequency per day during the first 12 months postpartum



B: Respondent BD: Longest interval between breastfeeds per day during the first 12 months postpartum



C: Respondent BD: Total length of breastfeeding sessions per day during the first 12 months postpartum



D: Respondent BD: Length of each breastfeeding session per day during the first 12 months postpartum

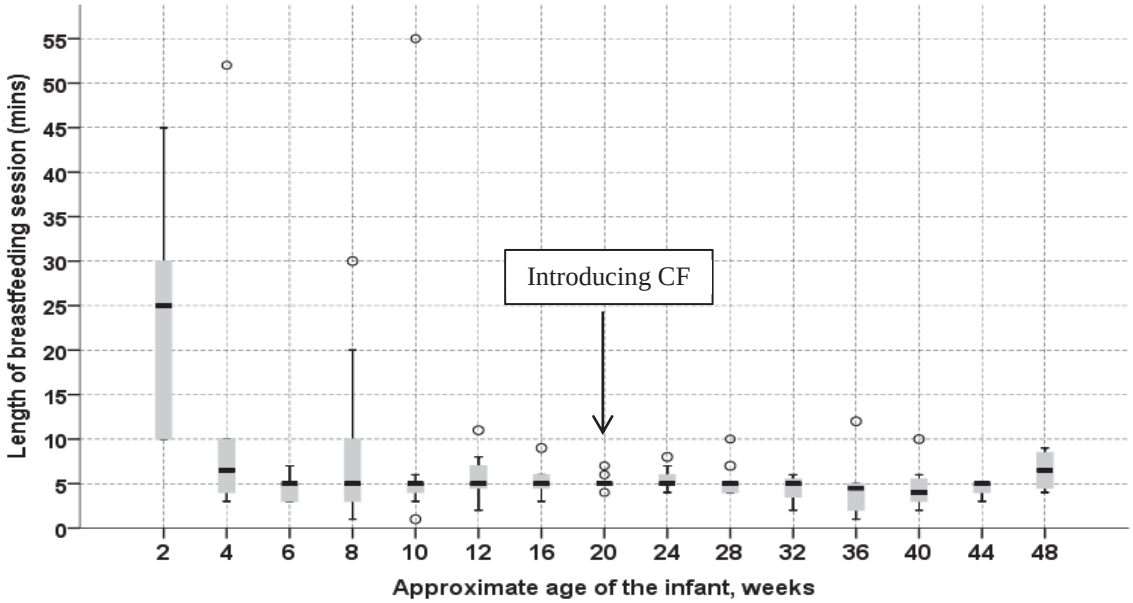


Figure 4.13. Breastfeeding practices for the respondent BD who has high BF frequency at four week. A: breastfeeding frequency; B: longest interval between breastfeeds; C: total length of breastfeeding sessions; D: length of each breastfeeding session.

Chapter Five Discussion

5.1 Method

In this present study, BF practices were observed by 24-hour recall. Through this method, all activities (such as feeding, sleeping and wakefulness) that involved the infants during the last 24 hours were noted. Some other studies have collected data by asking a few quantitative questions about BF practices previous day, such as how many times was the baby breastfed, and the length of the average BF session, instead of collecting a detailed 24 hour recall of feeding practices and times as was done in the current study. Using quantitative questions to collect data may be easy and straightforward. However, the 24 hour recall method used in this current study provides more detailed data, which allow the examination BF practices in detail, and is anticipated to facilitate the understanding of BF practices deeply.

However, the method used in the present study is more difficult and more complicated for analyzing the data. Several difficulties were found in this present study. Firstly, selecting and calculating the observed variables required many decisions for specific issues, such as defining the BF sessions and the longest interval between BF, and these have not been discussed in previous studies on BF. For instance, in two studies that focused on BF practices, one of the studies (Hörnell et al., 1999) did not state how they defined BF sessions or the longest interval between breastfeeds. Similarly, the other relied on the mothers' definition (such as questions were "About how long does an average BF last?" and "In an average 24-hour period, what is the longest time for you, the mother, between breastfeeds or

expressing milk?") (Shealy et al., 2008).

Moreover, it was difficult to define BF sessions if infants were BF while co-sleeping with breastfeeds. Even though it was likely they occurred, these were not reported by other studies. For example, Hörnell et al. (1999) indicated that there were infants BF and co-sleeping , but did not mention how they defined the BF sessions for such cases and did not discuss the accuracy of the data. There is no clear definition of how to identify and calculate the length of BF sessions, and thus the estimate used in this study is only approximate.

In addition, BF is not an isolated behaviour, it is related to many factors including maternal and infant factors and home environment. Targeted questions about BF practices may be sufficient to gain information for national trends in BF, but it is insufficient to show the full story of a BF situation. For example it is unclear why BF frequency changed. The 24-hour recall method (including detailed activity records of infants) used in the present study will help to elucidate BF practices.

Increasing the number of 24-hour recall and conducting home visits for checking and supplementing the data collected by 24-hour recall may increase the data accuracy, as suggested by Quandt (1986). Some additional questions about normal BF practices (like "how many breastfeeds/day do you usually give the infant during recent months") may be useful for collecting data on general BF practices. Doing so may supplement the data obtained by 24-hour recall, since it only can indicate BF practices of a particular day.

5.2 Demographic characteristics

Sixty-one healthy and last-stage pregnant women were recruited in this study. The demographic characteristics are discussed as follows.

Firstly, there are various ethnic groups in NZ, among which, in 2013, Europeans made up the largest group (nearly three fourths of the total NZ population), and Maori the second largest ethnic group (14.9% of the NZ population) (Statistics New Zealand, 2014). European women were also the highest proportion of women giving birth in 2010, although higher birth rates belonged to minority groups (10.8% and 11.4% respectively for Maori and Pacific women of reproductive age) (Ministry of Health, 2012c). Like the NZ population, in this present study the majority of participants were European/Pakeha women (87%), and a small part identified as Maori (7%) and other ethnicities (7%). Although the proportion of European participants was higher and the proportion of Maori participants lower compared to the proportions in the NZ population. Studies in NZ have found that Europeans had the highest BF intention (Morton et al., 2010) and practice (Plunket Society, 2010). It may be part of the explanation of the high full-BF rate during early postpartum weeks (fully BF infants 81%-78% at 2-6 weeks) in the present study as compared to the national rate of 65% exclusive/fully BF infants aged between about 2-6 weeks in 2009 (Plunket Society, 2010).

Secondly, the mean age of participants was 32.1±0.6 years with more than three quarters were above 30 years old. The highest fertility rate of NZ women was between 30-34 years in 2010 (Statistics New Zealand, 2012). Ninety percent of participants were living with their partner, and about 70% were lived together with their other children. These situations were consistent with characteristics of current

NZ females (Statistics New Zealand, 2005). For living arrangements, older women in NZ were more likely to live with their family (partner and children) than younger women. In 2001, among mothers aged 30-34 years old, only 5% were living alone (Statistics New Zealand, 2005).

In this study, the participants had a relatively higher education level — 88.4% had attained at least a tertiary degree compared to national education status. The proportion of the NZ female population aged more than 15 years old with bachelor degree or higher is 19% and with other tertiary qualifications is 31% (Ministry of Education, 2013), although these percentage will be higher if it is only referring to NZ females aged more than 30 years old. NZ mothers with higher educational qualifications were more likely to plan to BF their infants (Morton et al., 2010). Therefore, in this present study, the higher level of education is likely to be a factor which impacts positively on BF practices and hence to limit the ability to generalize the findings.

Sixty-eight percent of participants were multiparous. All of these women had experience which may trigger them to join this study (four women did not respond to this question, so their experience is unknown). Among them, 56% had breastfed an older child for more than six months. Therefore, they may have had an expectation regarding BF this infant. This suggestion is in accordance with the study of the Growing Up in New Zealand — women who breastfed their first infant more than six months were more likely to BF the subsequent infant longer (Morton et al., 2010). However, in this present study there was no association between past BF experience and BF duration ($P > 0.05$).

Most of participants (72%) in this study had a vaginal delivery which is the primary delivery mode among NZ women. This data was in accord with the maternity report by NZ Ministry of Health (2012c), 65% women had a vaginal delivery during the April 2009 to March 2010.

Finally, all infants who participated in this current study were healthy. Ninety-eight percent had normal weight and only one had a low birth weight (less than 2500g). The percentage of male infants was slightly more than females (55.7% vs. 44.3%), which was similar to the recent status of gender constitution of new births in NZ (female vs. male: 48.6% vs. 51.4%) which was reported in 2010 by NZ Ministry of Health (2012c).

Overall, in some aspects the participants in this present study had similar demographic characteristics with the 30-years-old NZ female population, such as living arrangements, and infant delivery method. However, there are a few of differences such as the majority of the participants were European and they were more highly educated than the average NZ women. These differences suggest better BF practices compared to the population average, including longer BF duration and timely introduction CF.

5.3 Percentage breastfeeding during the first 12 months

BF in NZ is advocated and supported by the Ministry of Health and community organizations such as the Plunket Society and La Leche League. However, there is a sharply decreased BF rate after relatively high BF initiation (Plunket Society, 2010; Ministry of Health, 2009). For women, maintaining BF is a challenge. In the

current study, results showed that 78% were fully BF at six weeks postpartum. This result is about 13% higher than the reported rate of exclusive and full BF between two and six weeks in 2009 (Plunket Society, 2010) (Table 5.1). In the present study, the rate of full BF subsequently declined from 78% (six weeks) to 61% (16 weeks). It then decreased greatly to 37%, and then to 7% at week 20, and 24 respectively (Table 5.1). The Plunket Society (2010) also reported a sharp decrease in the rate of exclusive and full BF — down to 55% for the period between 10-15 weeks, and then to 26% between16-28 weeks. In this current study, at 36 weeks 68% infants were still BF which was higher than 48% reported in the Growing Up in New Zealand study (Morton et al., 2012). At 48 weeks, 48% of mothers had stopped BF their infant (Table 5.1). This result coincides with the challenge — the low percentage of NZ mothers who continue to breastfeed their baby for at least one year (Ministry of Health, 2009).

Table 5.1. BF rates: comparison of current study to national data

Infants age (weeks)	*Sources*	*BF types*	*Percentage*
6	The current study	Full BF	78%
2-6	Plunket Society, (2009)	Exclusive &full BF	65%
16	The current study	Full BF	61%
10-15 weeks & 6 days	Plunket Society, (2009)	Exclusive &full BF	55%
20	The current study	Full BF	37%
24	The current study	Full BF	7%
16-28	Plunket Society, (2009)	Exclusive &full BF	26%
36	The current study	BF	68%
36	Morton et al. (2012)	BF	48%
48	The current study	BF	52%

The NZ Ministry of Health (2011) recommends supplementing BF with CF around

six months. However, in the present study, 9% of mothers started to supplement BF with CF at four months, and 39% at five months. Another NZ study conducted in Dunedin showed that 45% (n=33) were introduced to CF before four months (Heath et al., 2002). Such early introduction of CF to infants was also been found by a Western Australia study, in which the median age for introducing CF was 17.6 weeks (Scott et al., 2009). Introducing CF around four to five months has been persistently not recommended by the WHO (2002) and the Ministry of Health in NZ (2011). The NZ government has made efforts to increase the age for introducing CF and prolong BF duration (Ministry of Health, 2008).

At or beyond six months, breastmilk normally is not able to provide enough nutrients to meet an infants' needs (Ministry of Health, 2011), and so CF play an important role to support infants' health and development. In this present study, 94% infants had been given CF by six months (including the 24% of infants who had stopped BF).

5.4 Breastfeeding frequency

5.4.1 The variation of breastfeeding frequency

This study showed a wide variation of BF frequency at each observation throughout the first 12 months. For instance, BF frequency for fully BF infants at week two ranged from 5-21 times/day, at week 20 from 4-22 times/day; for mixed-feeding infants at week two ranged from 1-15 times/day; for BF infants receiving CF at week 20 ranged from 4-10 times/day, and at 48 weeks from 1-23 feeds/day; for mixed-feeding infants receiving CF at week 20 from1-6 times/day and at week 48 from 1-5

feeds/day.

Other studies have also found that there is variability in the daily frequency of BF. Table 5.2 summarises these results. A Western Australia study found exclusively BF infants aged between 1-6 months were breastfed 6-18 times/day with the mean 11±3 times/day (Kent et al., 2006). A Swedish study indicated that infants who were exclusively BF were fed about 4-15 times/day at week two, and about 4-11 times/day at week 20 (Hörnell et al., 1999). An American study showed that the range of BF frequency was wide for the first year postpartum. For example, at one and two months it ranged from 3-12 feeds/day; at 5-6 months ranged between 2-10 times/day; at 12 months ranged between 1-8 times/day (Shealy et al., 2008).

Table 5.2. Summary of BF frequency of research studies

Infants age (weeks)	***Source***	***BF types***	***Range of BF frequency/day***
2	The current study	Full BF Mixed feeding	5-21 1-15
2	Hörnell et al. (1999)	Exclusive BF	about 4-15
4 8	Shealy et al. (2008)	BF (any BF) BF (any BF)	3-12 3-12
20	The current study	Full BF BF with CF Mixed feeding with CF	4-22 4-10 1-6
20	Hörnell et al.(1999)	Exclusive BF	about 4-11
4-24	Kent et al. (2006)	Exclusive BF	6-18
20 24	Shealy et al. (2008)	BF (any BF)	2-10 2-10
48	The current study	BF with CF Mixed feeding with CF	1-23 1-5
48	Shealy et al. (2008)	BF (any BF)	1-8

Many factors may help explain the variability of BF frequency. In this present study, influential factors were reported by the women, including maternal health status, infants' health, fussy period, home and outside environments, opinions from people around women and social organizations such as Plunket Society. Additionally, varied BF requirements for infants may be part of the explanation. Infants have different stomach capacity and different gastric emptying time, and also mothers have different breast capacity (a small breast capacity needs more feeds in order to timely empty the breast) (Kent et al., 2012).

The range of BF frequency may suggest that BF is a personal behaviour and has personal styles, because it occurs through interactive processes by both infants and mothers (Hill et al., 1999; Kent, 2007). Therefore, the number of breastfeeds may not be a reliable indicator of successful BF practices and milk production as they ranged widely with mothers who have sufficient milk production (Kent et al., 2012). Nevertheless, based on the literatures many women expressed concern as to whether the baby was getting enough milk through BF (Morton et al., 2012). So, women may need to be educated more on how to recognise some signs of normal BF rather than count the number of BF.

5.4.2 The difference of breastfeeding frequency among feed types

At most obervations during the first 12 months in this present study, a significantly lower BF frequency was observed for BF infants receiving formula supplementation than for infants who were fully BF or BF and receiving CF. This significant difference of BF frequency may be partly due to the fact that in some cases the

intention of introducing formula was to decrease and replace the BF (stated by some mothers).

Similar results were found by another large cohort study in Norway (Lande et al., 2003), and a Euro-Growth study (Freeman et al., 2000). The Euro-Growth Study stated that at one month the BF frequency of fully BF infants was significantly higher than BF frequency for those infants whose BF was supplemented with formula (7.1±1.5 vs. 6.1±1.1, $p<0.0001$) (Freeman et al., 2000). Another Swedish study by Hörnell et al. (2001) examined BF patterns before and after introducing formula, and the results directly pointed out that formula was negatively associated with the number of breastfeeds.

5.5 Longest intervals between breastfeeds

5.5.1 The variation of longest interval between breastfeeds

In this study, the range for the longest interval between breastfeeds remained wide over the first 48 weeks. For example, the longest interval between BF for fully BF infants at week two ranged from 3-10 hours, at week 20 from 3-16 hours; for mixed-feeding infants at week two ranged from 4-24 hours; for BF infants receiving CF at week 20 ranged from 4-12 hours, and at 48 weeks from 3-24 hours; for mixed feeding infants receiving CF at week 20 from 6-24 hours, and at week 48 from 8-24 hours (Table 5.3). The wide range of intervals between BF was observed by other studies as well. An American study showed the longest interval between BF ranged from 3.8-11.5 hours at four weeks and from 3.3-12.0 hours at eight weeks (Quandt, 1986). An Australia study showed a great variation of intervals between breastfeeds

(4 minutes-10 hours 58 minutes) for exclusive BF infants who were between 1-6 months (Kent et al., 2006). This data is summarized in Table 5.3.

Table 5.3. Summary of the longest interval between breastfeeds of research studies

Infants age (weeks)	***Source***	***BF types***	***Range of the longest interval between BF (hrs)***
2	The current study	Full BF Mixed feeding	3-10 4-24
4 8	Quandt, (1986)	BF (any BF) BF (any BF)	3.8-11.5 3.3-12.0
20	The current study	Full BF BF with CF Mixed feeding with CF	3-16 4-12 6-24
48		BF with CF Mixed feeding with CF	3-24 8-24
4-24	Kent et al. (2006)	Exclusive BF	***Range of Intervals between BF*** 4 mins-10 hrs 58 mins

In this current study, the longest interval between BF seems likely to be influenced by the infants' sleeping patterns based on the mothers' reports. Sleeping patterns vary between infants, and Haig (2014) also identified a genetic component for sleeping.

Concerning intervals between breastfeeds, generally it is advocated that these be short during the first several weeks (Lang, 2002). This suggestion may relate to the physical character of the neonate — the small size of the stomach, and relatively quick digestion of breastmilk (emptying breastmilk in about 60-90mins) (Noonan, 2011). Short intervals between BF may also help to promote breastmilk synthesis and establishment (Lang 2002; Prime et al., 2012).

5.5.2 The difference of longest interval between breastfeeds among breastfeeding types

In this present study, the longest interval between BF for mixed-fed infants was significantly longer at the majority of observations than that for fully BF infants. This is not surprising. Longer intervals between BF are more common among formula-fed babies (Lang, 2002). One potential reason is that the introduction of formula may displace BF (Hörnell et al., 2001), so intervals between BF are prolonged. Moreover, for infants, the gastric emptying time may vary with different foods. Formula generally needs more time to digest than human milk (Vivatvakin et al., 2010).

5.6 Length of breastfeeding sessions

5.6.1 The variation of the length of breastfeeding sessions

This study showed a wide variation of the length of sucking sessions throughout the first 48 weeks postpartum. For instance, for fully BF infants the length of BF sessions at week two ranged from 2-205 minutes/feed, and at week 20 from 2-68 minutes/feed. For mixed-feeding infants BF sessions at week two ranged from 7.5-60 minutes/feed. For BF infants receiving CF at week 20 BF sessions ranged from 1-100 minutes/feed, and at week 48 from 4-85 minutes/feed. For mixed feeding infants receiving CF at week 20 BF sessions ranged from 5-40 minutes, and at week 48 from 3-35 minutes.

Varied length of BF sessions has been observed by other studies as well. Hörnell et al. (1999) found BF sessions among exclusively BF Swedish infants varied widely, particularly during the night time (up to 98 minutes at week two and up to 61 minutes at week 20). An American study showed that feeds during the day for breastfed infants at week four ranged from 5.8-52.2 minutes (mean± SD: 20.4±9.7 minutes), and at week eight from 5.7-43.9 minutes (mean± SD: 19.7±8.1 minutes) (Quandt, 1986). Another American study also indicated that the average length of BF session in the 12 months postpartum, as estimated by the mothers, could be less than 10 minutes or more than 50 minutes (Shealy et al., 2008). This data is summarized in Table 5.4.

Table 5.4. Summary of the length of BF sessions of research studies

Infants age (weeks)	***Source***	***BF types***	***The length of suckling/feeds (mins)***	
2	The current study	Full BF	Range	2-205
		Mixed feeding		7.5-60
4	Quandt, (1986)	BF (any BF)	Range	5.8-52.2
8		BF (any BF)		5.7-43.9
20	The current study	Full BF	Range	2-68
		BF with CF		1-100
		Mixed feeding with CF		5-40
48		BF with CF		4-85
		Mixed feeding with CF		3-35
4-48	Shealy et al. (2008)	BF (any BF)	Range	<10- ≥50

A wide range of the length of BF sessions may be normal and belong to the personal feeding styles of mothers and babies (Noonan, 2011). Some infants are able to get a large volume of breastmilk during a short period (such as 5-10 minutes), whereas others may need longer (such as 15-20 minutes) (Noonan, 2011). In the current study, some feeds lasted less than 5 minutes and some were more than 70 minutes,

which may indicate that the length of suckling time depends on the infant's demand. Although according to the literature, in particular cases long feeds may result from ineffective suckling or the latching problem (Watt & Mead, 2013), and short feeds may occur because infants are too sick or weak to suck (Noonan, 2011) or refuse the breast (Hytten et al., 1958).

Additionally, the length of BF sessions was generally shorter at the bottom of the range and much longer at the top of the range in the present study than BF sessions in the other studies. Furthermore, for the longer feeds in the present study, some of them were a result of co-sleeping or combining other activities' with BF (some mothers did not record the time points for BF separately from other activities). In Shealy et al. (2008), the average length of BF sessions was estimated and reported by the mothers, so it was unlikely to include these incidents.

5.6.2 Changes of the length of breastfeeding sessions over time

The results in this present study show that in the period between 16-48 weeks the majority of BF sessions tended to be shorter than those that generally occurred during the previous 12 weeks regardless of feeding methods. For example, BF sessions for both fully BF and mixed fed infants became shorter over time. (At week two, BF sessions were most commonly between 20-29 minutes for fully BF infants, <40 minutes for mixed fed infants, and then at week 24 became ≤10 minutes for all of infants). By 48 weeks the majority of BF sessions were within 10 minutes. This may be owing to more efficient suckling and quicker feeding during the latter period of the first-year postpartum as reported by the mothers in the present study. Similar

findings were observed by Shealy et al. (2008), whose study showed a trend of decreased length of BF sessions over time in the first 12 months with most BF sessions taking less than 19 minutes at 12 months. However, this present study still observed that 3% of feeds were more than 60 minutes at 12 months. The majority of these feeds were due to co-sleeping reported by the mothers.

5.7 The association between breastfeeding frequency/day at 2 and 4 weeks and breastfeeding duration

In this study, a positive relationship was observed between BF duration and BF frequency/day at week two and four (week two p=0.008; week four p=0.002). BF duration was also had a significant and positive correlation with frequency/day for fully BF infants at four weeks (p=0.04). A Swedish study also showed that longer duration of any and exclusive BF was associated with increased BF frequency at two weeks (Hörnell et al., 1999). Concerning the strength level of these positive correlations observed in this present study, results showed they were all weak (BF frequency & BF duration, at week two: r=0.352, at week four: r=0.404; full-BF frequency & BF duration at week four: r=0.289), and no correlation between full-BF frequency/day and full BF duration/BF duration at week two.

These weak/ no correlations may be due to the relatively small sample size (BF infants: n=55; full-BF infants: n=50). Another reason may be that higher numbers of breastfeeds is not a necessary factor for longer BF duration. A wide range of BF frequency among mothers who have sufficient milk supply suggests that how many times a baby is breastfed may not be a concern when mothers have a sufficent milk

supply and successful BF (Kent et al., 2012). However, low BF frequency per day may be a symptom of BF problems such as insufficient milk supply or bottle feeding that lead to early BF cessation (Woolridge, 1996; Huang et al., 2009).

5.8 Association of breastfeeding duration with maternal and infant characteristics

In this study, there was no correlation to be observed between BF/full BF duration and maternal and infant characteristics, with the exception of parity. This was different from what has been shown in the literature. In western countries, older, more educated and married women were more likely to breastfeed infants longer (Callen & Pinelli, 2004; Meedya et al., 2010). In NZ studies, younger single mothers, or younger primiparas were vulnerable to early stop BF (Ford et al., 1994; Morton et al., 2012). Another NZ study involving a convenience sample (102 primiparous women) showed the participants who had education more than 12th grade were significantly more likelihood of exclusively BF infants at 6 weeks than who had education ≤12th grade (Levine et al., 2003). Additionally, living with partner and enhancing partner's support has been advocated, so as to help NZ women to overcome BF difficulties and then prolonging BF duration (Heath et al., 2002). However, no correlation was found between these factors and BF/full BF duration in the present study, which may be owing to relatively small sample size.

In this current study, there was still no relationship between delivery methods (vaginal/caesarean) and BF/full BF duration. According to a review by Thulier and Mercer (2009), the effect of delivery methods on BF duration is not consistent. In

former studies, delivery methods were more likely to have an impact on BF outcomes, but recent studies found there was no correlation between them (Thulier & Mercer, 2009).

Regarding the correlation between parity and BF duration, previous findings are conflicting. Some studies show a correlation between them and some studies do not (Thulier & Mercer, 2009). This current study observed an association between parity and BF duration but not with full BF duration. BF experience was not related to BF duration, which was also showed in this current study. However, the Growing Up in NZ study found women who breastfed previous children more than 6 months were more likely to breastfeed the current baby longer (Morton et al., 2010).

5.9 Case studies

Regarding the case studies in this present study, there are several findings of interest, which may arouse thinking or directions for future studies.

Firstly, for all four cases, the BF frequency did not directly decline when CF was introduced. Even 2-3 months after introducing CF, three infants still remained the same BF frequency or slightly more feeds as at the time of introducing CF. It seems for these four infants there was no influence of CF on BF frequency. Mothers usually explained changes in BF frequency as being when the infants became unsettled, sick or fussy, or had disordered sleeping.

Secondly, the level of BF frequency during the first four weeks postpartum was consistent over the latter period. For example, two infants who had the lower level

of BF frequency during the first four weeks, continued to be breastfed at the lower level of BF frequency till 48 weeks. Specifically, one infant was breastfed 5-7 feeds/day at most weeks before 44 weeks; this then declined to three feeds/day at week 48. The other infant was breastfed ≤7 feeds/day at the majority of the observed times, and then went down to three breastfeeds/day at week 44 and week 48 (the exception for this infant was 11-16 feeds/day during 4-10 weeks, because the infant was sick). Two infants who had the higher level of BF frequency during the first four weeks, continued to be breastfed at the higher level until week 44 (one infant ≥8 feeds/day; the other one ≥13 feeds/day).

Similarly the Swedish study by Hornell et al. (1999) found a consistent mother-infant BF pattern over time. One group of 12 infants had ≤5.5 breastfeeds/day at week two, and two-thirds of them kept this lower level of BF frequency to nearly the end of the study period (4.5-6 months); the remaining infants fluctuated from 5-8 feeds/day. For a second group (12 infants with >11 breastfeeds/day at week two), three quarters of these infants were fed at least eight breastfeeds/day throughout the six months and the remaining infants maintained >11 breastfeeds/day for 5-6 months (Hornell et al. 1999).

Thirdly, the total length of BF sessions/day and the longest interval between BF did not follow the variation of BF frequency. For instance, in this present study, AO's highest numbers of breastfeeds (11 feeds/day) was at 12 weeks, which was nearly double the feeds at ten weeks, but the total length of BF sessions/day and the longest interval between BF remained stable and similar to that at ten weeks. BA at week six was breastfed 21 times/day, the total length of BF sessions/day was 5.1 hours and the longest interval between BF was 3.7 hours. These were similar to when she had

15 feeds/day at four weeks (4.6 hours of total length of BF sessions/day, and 4.6 hours of the longest interval between BF).

Finally, interestingly, for the case AO at two weeks, the total length of BF sessions/day was nine hours, while the number of breastfeeds was seven times/day. It seems that the longer sucking duration compensated for the fewer breastfeeds, which may be a reason that lead to successful BF till 48 weeks. However, based on the mother's report, the longer total length of BF session occurred because the neonate was unsettled and had latch problems. Therefore, to better understand BF, it may not be enough to only look at specific data like BF frequency, intervals and duration but may be also important to get the mother's reasons for the BF practices.

In summary, mothers-baby pairs with different BF practices (such as at week two one participant had six breastfeeds/day and one had 17 breastfeeds/day) did BF up to 12 months and they all reported that they had BF successfully. Fewer feeds (such as fewer than eight breastfeeds a day that is other researchers are commonly stated) may be normal or it may indicate BF problems. Therefore, giving suggestions or identifying problems for BF may require considering the whole status of the infant and the mother (not just BF frequency) including health status and fussy periods and living environment.

5.10 Limitations & strengths of this study

This study had several limitations. Firstly, the sample size was relatively small and the majority of participants were European and more educated than the general NZ population, which restricts its generalizability. Another limitation is in the defining

of BF sessions. The problem with defining occurs because babies may spend a long time at the breast but not be BF; mothers say the infant started BF, if that is what she is ready to do but actually has not started yet (such as breast is 'out' and near infant's mouth). These may be innate weaknesses in trying to quantify BF sessions. Moreover, a 24 hours recall is too short to get enough data to show infants' usual feeding practices such as for observing exclusive BF and describing the longest interval between BF (for example if there is only one breastfeed during 24 hours).

Nevertheless, this study has some strengths. Firstly, the method of observing BF practices through a detailed 24-hour recall, in which the points in time of all activities that involved the infants during the last 24 hours were recorded. Using this method provides more detailed data and may clarify the mothers' thoughts and help them to remember their feeding practices. Secondly, this is a longitudinal study which allows observing BF patterns over time from the early weeks postpartum until week 48. Furthermore, there is a lack of published studies about BF practices in NZ. This study examined BF patterns in detail (for example how long breastfeeds are, the longest interval between BF, and BF frequency per day for infants who were fully BF or mixed feeding), and also traced several individuals' BF behaviors over time.

Chapter Six Conclusion

This study was conducted to observe BF practices and the association between BF duration and frequency per day during the first 12 months postpartum among group of NZ women in the Manawatu region. Breastmilk is not only the ideal food for the neonate but also benefits their growth and development (Ministry of health, 2008). The NZ government has made many efforts to prolong BF duration, such as launching BFHI and BFCI (Ministry of Health, 2002). More supporting scientific information may be required by the health ministry or other related health organizations such as the Plunket Society, so as to ensure they have correct and up to date information for making appropriate working strategies and guidelines for helping lactating women. At present, most studies have put more emphasis on identifying factors influencing BF. Only several studies have looked at how BF was actually practiced. Hence, this study makes a contribution to the literature.

A total of 61 healthy women aged 32.1±0.6 years volunteered for this study during their last stage of pregnancy. They had higher educational status, compared to the general educational level among the female population in NZ. The majority were European, not first time mothers and had experience with BF before.

Full BF was the predominant feeding choice during the first several months, especially within the first four weeks (81%-82% infants fully breastfed). After 16 weeks, more women began to introduce CF while continuing to BF. By 48 weeks, about half the infants were no longer BF (48%). These findings may highlight the

NZ society's BF practices of introducing CF early and not BF to12 months postpartum.

Concerning BF patterns, this study showed there was a wide variation of BF practices throughout the first 48 weeks postpartum. For instance, at two weeks fully BF infants breastfed between 5-21 times/day, and at 48 weeks BF infants receiving CF had 1-22 BF/day. The length of BF sessions also varied, at two weeks fully BF infants fed for 2-205 minutes/feed, and at 48 weeks BF infants receiving CF fed for 4-85 minutes/feed. The longest interval between breastfeeds tended to increase although there was still wide variation. At two weeks, the longest interval between breastfeeds for fully BF infants ranged from 3-10 hours, at 48 weeks for BF infants receiving CF ranged from 3-24 hours.

This variability of BF practices shows that there is a wide range of 'normal'. BF appears to be a personal behavior, and infants and mothers have their own BF style. There was a significantly positive correlation between BF duration and BF frequency/day at two and four weeks, and full BF frequency/day at four weeks. Frequent BF is one of the important approaches that may stimulate milk production and help build lactation at the early stage postpartum. However, it is possible and may be normal for the infant either to be breastfed less often than is commonly advised (8-12 times/day) or more. Hence, suggestions regarding BF practices may need to consider the individuals' particularity since BF is a personal behaviour and many factors could influence BF practices.

Suggestions for the future research:

This study observed BF practices during 24 hours, but did not separately analyse BF practices during the day and night time. There may be different BF practices with varied time frames, which were found in one study conducted in Sweden (Hornell et al., 1999). However, there is a lack of this information (about BF practices during day and night time) in the NZ setting. It may be necessary to study in the future in NZ in order to gain deeply understanding BF practices, so as to make more proper BF guidance for NZ infants.

With regard to the definition of the length of BF sessions, there is no clear and unified definition. The method used in most studies allows the mother to define BF sessions. However, how the start time of suckling may be defined varies with mothers. For example, some mothers may define it from the time of being ready to BF, some may from the time of latching the breast, or some may from the time of actually suckling. These can result in varying definitions of the length of sucking time per feed, and thus both the data and the results about the length of BF sessions seem to be less accurate. Additionally, there is also lack of the definition of BF sessions, when the baby is co-sleeping and comfort sucking. These issues are not discussed in the literature. Therefore, how to define the BF sessions and improve the accuracy of the data and the results may need research in the future.

Lastly, based on published studies, breastmilk supply is an important issue for BF. In NZ, insufficient breastmilk supply is one of the major problems during BF (Morton et al., 2012). Breastmilk synthesis may be influenced by BF practices, especially during the early stage of lactation (Kent, 2007). However, scientific evidence for the association between BF practices and breastmilk production is limited, and which

also did not examine in this present study. Hence, this may need to be observed in NZ setting in the future.

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Appendices

Appendix A:

Massey University

INSTITUTE OF FOOD, NUTRITION & HUMAN HEALTH

Massey Mother & BabyStudy

Maternal data at recruitment

Date:	Start time:	End time:

DoB:		**Age:**		**Weeks pregnant:**	
LMP		**EDD (LMP)**		**EDD (scan)**	
Height (m):		**Weight (kg):**		**BMI**	
Prepregnancy wt (actual):		**Prepregnancy wt (desired):**		**Confirmed?**	
What do you think about your weight gain?					
kg fat	**% fat**	**% lean**		**Body vol (wt / density)**	
Waist (cm)		**Hip (cm)**		**W:H (waist / hip)**	
Ankle circumference (cm)		**Calf circumference (cm)**		**Arm circumference** – relaxed **(cm)**	
Left	Right	Left	Right	Left	Right
Skinfold thickness - non-dominant side: **Left / Right** repeat girths & skinfolds x3 if necessary					

triceps	**biceps**	**subscapular**	**iliac crest ***
supraspinale*	**abdominal ***	**thigh**	**calf**
Weight gained:			
RMR			

Note: * not taken at recruitment

1. Have you given birth to any other children?

Yes = 1/ No = 0

No	**Sex**	**Age**	**Method delivery**	**Method of feeding** *(probe duration of bf)*

2. Can you describe what you did yesterday, I am particularly interested in all types of physical activity *(intentional and unintentional activity)*, such as hanging out the laundry, doing the gardening, dancing, walking, or going for a run.

If we start with when you got up yesterday morning… (go through to same time today).

_____
_____
_____
_____
_____

3. Was yesterday a typical day in terms of physical activity? If not, what was different?

No =0 Yes = 1

_____
_____
_____
_____

4a. How often do you do 15 minutes or more of <u>vigorous</u> activity? (Such you're your heart beat is raised and you are out of breath)_____times per week

4b. How often would you do 30 minutes or more of continuous <u>moderate</u> activity? (such as brisk walking)? _____times per week

Coding: *0, <1, 1, 2, 3, 4, 5, 6, 7, 8+ times per week*

5. Has this changed if you compare your activity level now compared to before pregnancy? If "Yes", why /how

No =0 Yes = 1

_____

_____

_____

6. How would you describe your fitness level <u>now</u>?

- ☐ 1 Extremely fit
- ☐ 2 Moderately fit
- ☐ 3 Moderately unfit
- ☐ 4 Unfit

Why do you say that?

_____

_____

_____

_____

7. How would you describe your fitness level <u>before pregnancy</u>?

- ☐ 1 Extremely fit
- ☐ 2 Moderately fit
- ☐ 3 Moderately unfit
- ☐ 4 Unfit

I'd like to ask you a few questions about your diet. *When I use the term diet I mean what you eat and drink, not whether or not you are trying to loose weight.*

8a. Who does most of the grocery shopping in your house?

Me = 1 Partner = 2 Both partner & I = 3 Other = 4

_____

8b. Who does most of the food preparation?

Me = 1 Partner = 2 Both partner & I = 3 Other = 4

_____

9a. Which of the following foods do you eat and how often? *(More than once per day, once per day, times per week, less than once per week).*

	No. of times per week/day
Red meat *(times per week)*	
Chicken *(times per week)*	
Fish *(times per week)*	
Eggs *(no. of eggs per week)*	
Dairy *(serves per day)***:** *no. glasses of milk (not in tea)* *yoghurt* *cheese*	
Fruit *(serves per day)*	
Vegetables *(serves per day)*	
Breakfast *(times per week)*	

9b. How has your consumption of these changed since you became pregnant? *(ask about specific foods above)*

_____
_____
_____
_____
_____

10. Are there any foods you are avoiding and why?

_____
_____
_____
_____

11a. How else has what you eat and drink changed since you became pregnant?

1 = More healthy, 2 = same, 3 = less healthy

_____
_____
_____

11b. If different, why have you made these changes? *(Probe for detail of change and understanding – look for food that is added and deleted, e.g. if*

no longer drinks coffee what is drunk instead, as well as changes in serve sizes).

_____
_____
_____

12a. Who (else) has talked with you about what to eat and drink when pregnant?

_____
_____
_____
_____

Probe for:

0_no one

_____

1_midwife_____

_____

2_ doctor

_____

3_partner_____

_____

4_mother_____

_____

5_ mother-in law

_____

6_ other relatives

_____

7_ friends

_____

8_ other health professionals

*(who?)*_____

12b. What other sources of information have influenced what you eat and drink during pregnancy? *(Probe for books, magazine info, advertisements….)*

_____
_____
_____

12c. Were you given any leaflets about dietary advice while pregnant, and if so what was most helpful to you? *(if not mentioned probe/ show Food Safety pamphlet?)*

_____
_____
_____

12d. *(If not first pregnancy),* **how are the changes to what you eat and drink similar or different from previous pregnancies?**

_____
_____
_____

13a. Have you taken any vitamin or mineral supplements during this pregnancy? *(Probe for folic acid and iron).*

Yes=1/ No=0 If "Yes":

(i) What? Why? How often?

_____
_____
_____
_____

(ii) What? Why? How often?

_____
_____
_____
_____

(iii) What? Why? How often?

_____
_____
_____
_____

(iv) What? Why? How often?

_____
_____
_____

(v) What? Why? How often?

_____
_____
_____

13b. Has a health professional/ midwife recommended any other vitamins and/ or minerals?

_____
_____
_____

14a. Do you currently smoke?

No = 0 Yes = 1 If “Yes”:

What?

_____

How many? *(number per day/ week)*

_____

14b. Did you smoke previously? *(get details)*

No = 0 Yes = 1 Many years ago = 2

_____

_____

15a. Do you currently drink alcohol?

Yes = 1 No = 0

If “Yes”/ “Sometimes”: **How much and how often?** *(looking for amount & freq)*

_____

_____

_____

- ☐ 0 Non-drinker currently
- ☐ 1 less than weekly
- ☐ 2 1-2 times per week
- ☐ 3 3-6 times per week
- ☐ 4 Daily

15b. What type of drink(s)?

_____

15c. Do you drink more on certain nights of the week?

_____

15d. Have you changed your alcohol consumption since becoming pregnant? If yes, how? *(probe amount, frequency, why, advice?)*

Yes = 1 No = 0

_____

_____

_____

_____

16a. Do you drink coffee or tea?

Yes = 1 No = 0 If "Yes":

What?_____

_____

Coding: *nothing=0, coffee=1, tea=2, herbal tea=3, all three=4, coffee &tea=5, coffee & herbal tea=6, tea & herbal tea=7*

How often?

	Coffee	***Tea (note herbal separately)***
0	Non coffee drinker currently	Non tea drinker currently
1	less than I cup per day	less than I cup per day
2	I cup per day	I cup per day
3	2-3 cups per day	2-3 cups per day
4	4-6 cups per day	4-6 cups per day
5	7 or more cups per day	7 or more cups per day

Number of herbal teas:

_____

_____

16b.What sort of coffee do you usually drink?

Coding: instant = 1, cappuccino = 2, latte = 3, plunger/pergolator = 4, all = 5

_____

16c. Have you changed your coffee or tea consumption since becoming pregnant?

Yes/ No **(coffee)** Yes/No **(tea)** Yes/ No **(herbal)**

Coding: *No coffee = 1, Yes coffee = 2, No tea = 3, Yes tea = 4, No herbal = 5, Yes herbal = 6*

If "Yes" how? *(probe amount and frequency)*

_____

_____

_____

Now I'd like to ask a bit about your plans to feed the baby after birth.

17a. What are your current thoughts about feeding the baby after birth? *(If just a short answer ask, "what are some of the things you considered when coming to that decision".*

If she says, "breastfeed if I can" probe as to what might stop her; e.g. what kinds of things are you thinking of when you say you'll breastfeed if you can?

_____
_____
_____
_____
_____

17b. Thinking of (all) these reasons, what are the most important reasons for your choice of feeding? *(ask to rank if more than one?)*

_____
_____
_____
_____

17c. *(if planning to breastfeed*) **How important is it to you that you breastfeed your baby, on a scale of 1-10, with 10 being very important**. *(note any comments)*

_____
_____

17d. Do you have any plans to express milk if or when you go back to work?

_____
_____

17e. Who (else) have you talked to about how you will feed the baby? *(note down any comments she raises).*

_____
_____
_____
_____

Probe for those not mentioned:
0_no one
1_midwife
2_doctor
3_partner
4_mother
5_mother-in-law
6_other relatives
7_friends
8_antenatal group
9_other health professionals

17f. What are other sources of influence on your decision to feed?
Start with asking the question open ended so we can gather any thoughts she has along with it, e.g. my midwife hasn't been much help but she……

_____
_____
_____
_____

_books
_magazines
_newspaper articles
_TV
_radio

17g. *If she has other children ask* – **How are your thoughts about feeding different or the same from past pregnancies?**

_____
_____
_____
_____

Lastly I'd like to ask a few demographic questions, such as your occupation.

18. What is your current occupation? If not working, what was your previous occupation?

_____
_____

19a. How many hours do you currently work each week?

_____

b. How many hours do you usually work each week?

_____

20. What was your highest *(or plans for your highest)* **educational level?**

_____
_____

21. Who are you living with now? *(get number of others, e.g. children, etc.)*

On own	☐	1
With partner	☐	2
With children	☐	3
With parents	☐	4
With others	☐	5

Note – can tick more than one box, and note number of children.

---

22. What is your partner's occupation? *(if applicable)*

---

23. Could you tell me which ethic group you identify with?

O	1	NZ European / Pakeha
O	2	NZ Maori
O	3	NZ Asian
O	4	Pacific Islander Polynesian
O	5	SE Asian
O	6	Chinese
O	7	Indian
O	8	Japanese
O	9	Other Asian (*specify*)……
O	10	Mid Eastern (*specify*)……
O	11	Other European (*specify*)……
O	12	Other (*specify*)……

Appendix B:

Massey University

INSTITUTE OF FOOD, NUTRITION & HUMAN HEALTH

Massey Mother & Baby Study

Infant birth data

Date: _____

Age of infant: _____

(collect this only if she has the plunket book—else ask her to bring book to Massey?)

INFANT DATA		Name:
Gender	DOB	EDD
Birth data if possible (reported)		
Weight	Lengths (CH or CR)	Mode of delivery- *include details re drugs*
Head circ	Ponderal Index	Verified? Y/N

(before interview check how she planned to feed the baby _____)

1. Can you please tell me about feeding _____(Baby) yesterday (starting at 6 AM until 6 AM today). I'm interested in when he/she fed, what was given and how long and sleeping patterns. *(record on grid)*

2. Does (baby) use a dummy? (when/why?)
Yes = 1 No = 0

_____
_____
_____

3. Was yesterday a normal day? *(if not how, why?)*

_____
_____
_____
_____

4. How do you decide when to feed _____?

_____
_____
_____
_____

5. **a.** How did you feed baby after the birth? (probe for timing of first breastfeed).

_____
_____
_____
_____

b. *If breastfed at birth and exclusively breastfeed in past 24 hrs- ask:* Has _____ (baby) had anything to eat or drink other than breastmilk? (what, how, why, who gave/suggested, frequency).

Yes = 1 No = 0

What (include medicine)	How given (bottle, spoon, etc)	Why	Who gave	Who suggested	How often/ when gave

c. If only breastmilk, ask: Has he/she been given breastmilk by bottle, spoon or other method? (how, why, who gave/ suggested, frequency)

Yes = 1 No = 0

How given (bottle, spoon, etc)	Why	Who gave	Who suggested	How often/ when gave

6. What changes have you noticed since (baby) was born in terms of feeding and sleeping?

(*if change initiated by parents)* What motivated these changes ?

(depending on what said above probe regarding::)

a. use of feeding bottle and what was given in it
b. introduction of 'solids'
c. advice/ pressure from other people

_____
_____
_____

7. Overall, how do you feel about feeding the baby now?

_____
_____
_____

8. Have you had any problems in terms of feeding?

Yes = 1 No = 0 If "Yes" who helped/ offered advice *(get details)*

0 ☐ no one

1 ☐ your midwife

2 ☐ hospital staff

3 ☐ doctor

4 ☐ partner

5 ☐ mother

6 ☐ mother-in-law

7 ☐ other relatives

8 ☐ friends

9 ☐ plunket

10 ☐ La Leche League

11 ☐ Lactation consultant

12 ☐ Other

_____
_____
_____

9. Have you had any (other) support or comments related to feeding ____ (baby)? *(who, what , when, her response)*

_____
_____
_____

10. Are you considering introducing any changes to feeding _____ (baby) in the next week? *(What? Why?)* Yes = 1 No = 0

_____
_____
_____

Thank you for your help today. Are you willing for me to call you again in __ weeks?

Yes ___ Thank you, is there a time that would most likely be convenient for me to call you _____

No __ Thank you for your help to this point, if you would like to become involved again please phone me at (06) 350 5532 or send an email. Is there any feedback you would like to give about participating in the research?

Description	Time 24 hr clock				Activity		Amount Tsp/ml			By
	0	6	0	0						

Data Grid Coding:

Activity:

Feed: 1 breast
2 ebm cup/bottle
3 formula
4 cm cows milk
5 juice
6 water
7 other fluids (specify)
11 solids (specify)

Sleep: 21 continuous sleep
22 asleep >50% time
23 asleep 50% time
24 asleep <50% time
25 fully awake and unsettled
26 fully awake and content
27 comfort sucking.

By Whom:
1 self
2 partner
3 sib
4 mother
5 minder
6 friend
7 health pro (specify)
8 other