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An Investigation of the Diets of Infants Born in Ireland During the First Six Months of Life

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AN INVESTIGATION OF THE DIETS OF INFANTS BORN IN IRELAND DURING THE FIRST SIX MONTHS OF LIFE

A thesis submitted for the degree of Doctor of Philosophy (Ph.D.)

by

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GENERAL SUMMARY

Appropriate infant feeding practices play a crucial role in achieving optimal health outcomes. It is well established that the protection, promotion and support of exclusive breastfeeding during the first 6-months of life would decrease the health inequalities experienced by mothers and infants (WHO/UNICEF, 2003c). Optimal weaning practices also have significant implications for infant health, notably in relation to normal development, mineral balance and the development of obesity (Department of Health, 1994). Historically, Ireland has one of the lowest breastfeeding rates in Europe. Furthermore, prior Irish-based research indicates significant deficiencies relating to weaning practices among mothers during the first year of life. The present study was designed to investigate the diets of infants born in Ireland and assess compliance with infant feeding recommendations.

This cross-sectional prospective study involved the recruitment of 561 pregnant women during the ante natal period, with subsequent follow-up of mothers who bore term, healthy, singleton infants, at 6-weeks and 6-months post-partum. The final sample that met the study criteria consisted of 401 national and 49 non-national mothers.

Detailed information on breastfeeding initiation and prevalence rates among national and non-national mothers was elicited, using specific well-defined breastfeeding definitions. A subsequent analysis was undertaken to comprehensively identify the predictors of breastfeeding initiation and duration among national mothers, as well as the barriers that prevent them from attempting the practice. Data are also presented on the weaning practices of national mothers specifically pertaining to the timing of weaning, as well as dietary and snacking patterns. A further in-depth analysis was performed to determine the factors associated with the occurrence of sub-optimal weaning practices.

In summary, this study highlights significant deviations from current infant feeding recommendations. Importantly, 47.1% of national and 79.6% of non-national mothers initiated breastfeeding (*p = 0.000*) indicating that little improvement has been achieved in terms of increasing breastfeeding rates over the former decade. Of further concern, high early discontinuation rates were observed among the national, compared with the non-national population of mothers, however, the exclusive breastfeeding rates remained low in both populations. In addition, a high prevalence of negative weaning practices was observed, including the finding that 23% of infants were prematurely weaned onto solids by 12-weeks. Mothers who weaned early were significantly more likely to carry out other sub-optimal feeding practices, suggesting that an overall deficiency in weaning information may exist among these mothers.

This study has provided a greater understanding of how infants are fed during the first 6-months of life in Ireland, adding to our paediatric knowledge base. To attenuate the health inequalities between lower and higher socio-economic groups in our society, results suggest that increased resources and more effective public health education should be apportioned to improve infants' diets. As the early years represent a time in which disease prevention may be most effective (Campbell *et al.,* 2008), there should be no delay in developing national strategies that encourage increased compliance with infant feeding recommendations at a population level.

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DECLARATION OF WORK

I certify that this thesis which I now submit for examination for the award of Doctor of Philosophy (Ph.D.), is entirely my own work and has not been taken from the work of others, save and to the extent that such work has been cited and acknowledged within the text of my work.

This thesis was prepared according to the regulations for post graduate study by research of the Dublin Institute of Technology and has not been submitted in whole or in part for an award in any other Institute or University.

The work reported on in this thesis conforms to the principals and requirements of the Institute's guidelines for ethics in research.

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Signature ______________________________________ **Date** _________________

Candidate

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LIST OF ABBREVIATIONS

AAP	American Academy of Pediatrics
AI	Adequate Intake
ALSPAC	Avon Longitudinal Study of Parents and Children
BDA	British Dietetic Association
BFHI	Breastfeeding Friendly Hospital Initiative
BMI	Body Mass Index
CI	Confidence Interval
cm	Centimetre
COMA	Committee on Medical Aspects of Food
CSO	Central Statistics Office
d	Day
DIT	Dublin Institute of Technology
ESPGHAN	European Society for Paediatric Gastroenterology Hepatology and Nutrition
EU	European Union
FSAI	Food Safety Authority of Ireland
GP	General Practitioner
HDL	High Density Lipoprotein
HP	Health Professionals
hrs	Hours
IDA	Iron Deficiency Anaemia
Inc.	Incorporated
INDI	Irish Nutrition and Dietetic Institute
IQ	Intelligence Quotient
IT	Information Technology

IU	International Units
kg	Kilogram
LDL	Low Density Lipoprotein
max	Maximum
min	Minimum
mls	Millilitres
mmHg	One millimetre of mercury (the unit of barometric pressure)
mnth	Month
n	Sample Size
PHN	Public Health Nurse
OR	Odds Ratio
SACN	Scientific Advisory Committee on Nutrition
SD	Standard Deviation
SIG	Significance
SLAN	Survey of Lifestyle, Attitudes and Nutrition
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
USA	United States of America
WHO	World Health Organisation
wks	Weeks
yrs	Years

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General Introduction

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1.1 Breastfeeding practices

1.1.1 Introduction

Breastfeeding is the superior infant feeding method from birth (Department of Health UK, 1994; FSAI*, 1999; American Academy of Pediatrics [AAP], 2005; European Society for Paediatric Gastroenterology, Hepatology and Nutrition, [ESPGHAN], 2008) with research consistently demonstrating its numerous health benefits for both mother (Heinig & Dewey, 1997) and infant (Hamosh, 2001). While the evidence for the nutritional benefits of breastfeeding is robust, the practice also confers a number of non-nutritional advantages to young infants including the protection against acute (Beaudry *et al.,* 1995; Golding *et al.,* 1997a) and chronic (Fewtrell, 2004) illnesses and enhanced behavioural and physiological development (Horwood & Fergusson, 1998). Particular interest over the past decade in the persisting long-term benefits of breastfeeding during childhood and even adulthood lends further support to the promotion of the practice (Saarinen & Kajosaari, 1995). A retrospective study examining the early feeding methods of 625 Dutch men (48%) and women (52%) found that those who were formula fed, compared to breastfed, had a greater number of risk factors for cardio-vascular disease including higher plasma low density lipoprotein (LDL) and lower high density lipoprotein (HDL) cholesterol concentrations (Ravelli *et al.,* 2000). More recently, an extensive meta-analysis carried out by Arenz *et al.,* (2004) confirmed that breastfeeding, in a dose-dependant manner, has a small but consistent protective effect against obesity during childhood. There is a strongly held view among many experts in the global public health community that the potential for obesity prevention during infancy is promising (Stettler, 2007).

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* Food Safety Authority of Ireland (FSAI) is a statutory, independent science-based body dedicated to protecting public health, consumer interests and ensuring the achievement of the highest standards of food safety and hygiene

Despite the widely publicised health advantages of breastfeeding and numerous public health campaigns to promote the practice in Ireland, initiation rates remain disappointingly low. The vast majority of infants born in Ireland never experience the benefits of breast milk (National Perinatal Statistics, 2004) presenting a major public health challenge. Relative to international rates, it is globally acknowledged and well documented that Irish breastfeeding rates are among the lowest in the world (National Breastfeeding Policy or Ireland, 1994). During the 1990's, breastfeeding initiation rates stagnated between 34-39.5% (Fitzpatrick *et al.*, 1994; Ward, 1996) although they increased to a rate of 51% reported in 2000 (Twomey *et al.*, 2000). In comparison, 98% of mothers in Sweden were reported to have 'ever' breastfed in 1999 (WHO [World Health Organisation] Global Data Bank on Breastfeeding, 1996).

While few reports have replicated the initiation rate of 51% among mothers in Ireland (Twomey *et al.*, 2000; Ward *et al.*, 2004), the National Perinatal Statistics have reported modest annual increases in the proportion of mother's breastfeeding at hospital discharge from 32% in 1991 to 41% of mothers exclusively breastfeeding upon hospital discharge in 2003 (National Perinatal Statistics 1991-2004 Reports, Department of Health and Children).

In an effort to improve breastfeeding rates, the Department of Health published a National Breastfeeding Policy for Ireland in 1994, which represented the government's first concerted commitment to promote the practice. This report recommended measures to promote breastfeeding both in-hospital, within the wider community and at a policy level, and provided guidance as to how such initiatives should be implemented. Although the policy presented evidence-based multi-faceted recommendations encompassing a co-ordinated national approach to the improvement of breastfeeding rates, the breastfeeding targets set out in the policy have not been achieved.

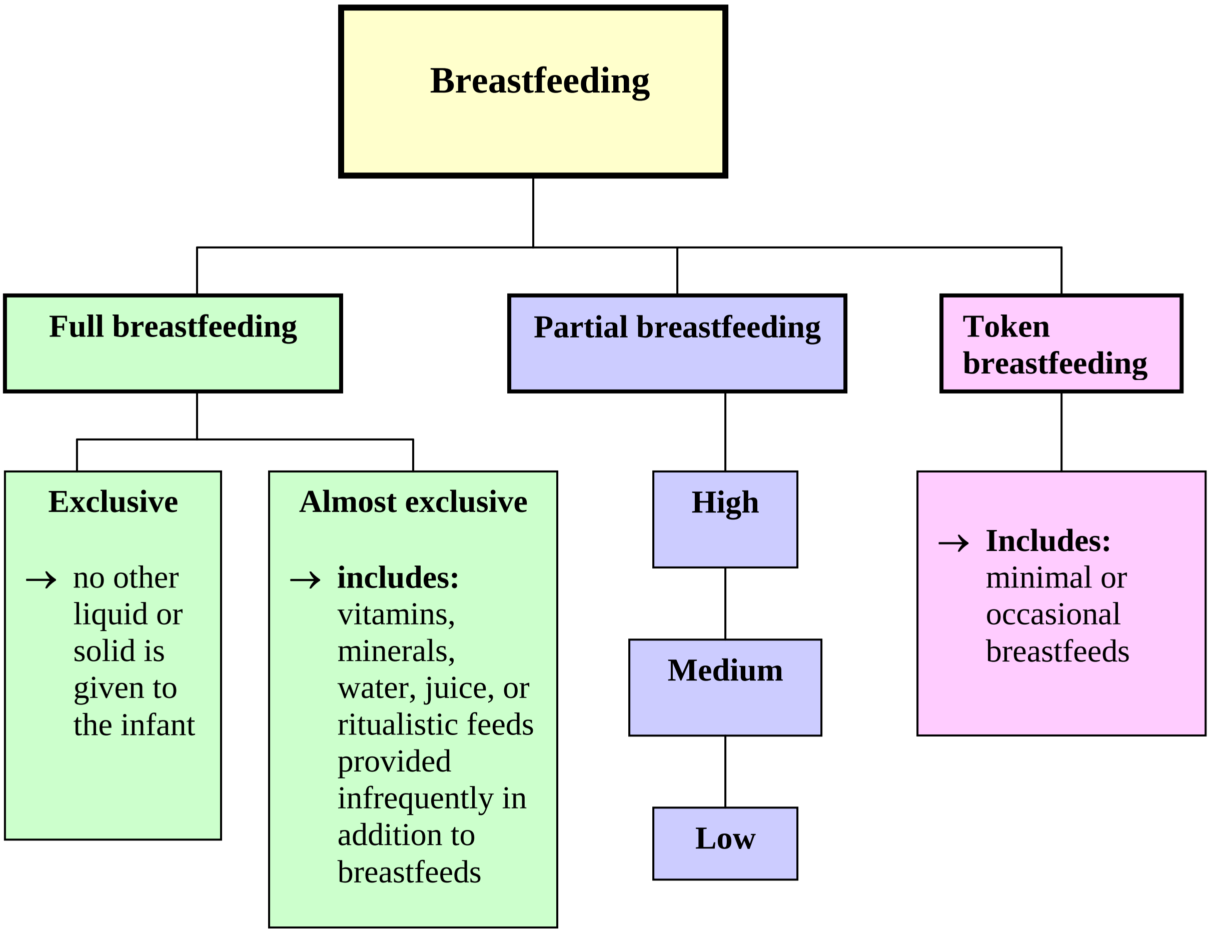
Of further concern, Irish studies confirm the historical problem of premature discontinuation of breastfeeding once mothers have established the practice. Particularly high discontinuation rates have been recorded with only 10% of mothers (n = 273) reported to have breastfed at 5-months in a regional study in Galway (Lowry & Lillis, 1993) and 8% of a randomly selected group of mothers in Dublin (n = 197) were reported to be still breastfeeding at 6-months (Twomey *et al.,* 2000). Regrettably, Ireland still has one of the lowest breastfeeding initiation rates in Europe (Interim Report of the National Committee on Breastfeeding, 2003), which is indicative of the continual and persistent public health challenge. In view of the fact that exclusive and longer breastfeeding duration rates are associated with an optimal long-term health outcome (von Kries *et al.,* 1999), the reasons for low breastfeeding initiation rates and premature cessation of the practice in Ireland deserve greater attention.

1.1.2 Breastfeeding definitions

The accuracy of data depends largely on standardised definitions and methods (Cattaneo *et al.*, 2000). Infant feeding investigators have supported the lack of clearly defined breastfeeding definitions and indicators as limitations in breastfeeding research, making national and international breastfeeding prevalence rates difficult to compare and fully interpret (Auerbach *et al.*, 1991, Heinig & Dewey, 1997; Yngve & Sjostrom, 2001a). Moreover, in the absence of consistent breastfeeding definitions, it is difficult to compare the true incidence and duration of breastfeeding from multiple studies (Callen & Pinelli, 2004).

To establish a consensus on breastfeeding definitions, a group of international experts (Interagency Group for Action on Breastfeeding) convened in 1988. The agreed schema and potential framework suggested at the meeting (see **Figure 1.1)** was created to set standardised breastfeeding definitions based on bio-physiological dynamics as a basis for categorization that would be appropriate for the collection of cross-sectional data (Labbok & Krasovec, 1990). The schema for breastfeeding definitions proposed clear categories including exclusive, almost, partial and token breastfeeding. To qualify the volume of supplementary fluids offered to infants, the panel suggested three partial breastfeeding categories, high partial breastfeeding denoting a feeding regimen consisting of mostly breastfeeds, low partial breastfeeding relating to feeding regimens that feature few breastfeeds and medium partial breastfeeding representing a measure between these two definitions.

Figure 1.1. Schema for breastfeeding definitions proposed by Labbock and Krasovec (1990)



A year later, the WHO (1991) published a key document 'Indicators for assessing breastfeeding practices' containing developed and agreed global breastfeeding definitions (see **Table 1.1**), modelled on those established and described by Labbock & Krasovec (1990). This initiative aimed to develop a common set of measures concerned with 'base of measurement' rather than the 'biological impact' of breastfeeding, which would enable the assessment of breastfeeding practices, the evaluation of the progress of promotional programmes and intra-country comparison.

Table 1.1. Breastfeeding definitions that meet the criteria for inclusion in infant feeding categories, established by the WHO (1991) and WHO (1996)

Feeding type	Requires the infant to receive	Allows the infant to receive	Does not allow the infant to receive
Breastfeeding	Breast milk, either direct from the breast or expressed breast milk	Any food or liquid including non-human milk or breast milk *via* a bottle	
Exclusive breastfeeding	Breast milk including milk expressed or from a wet nurse	Drops, syrups including vitamins, minerals and medicines	Anything else
Predominant breastfeeding	Breast milk including milk expressed or from a wet nurse as the predominant source of nourishment	Liquids (water, and water-based drinks, fruit juice, oral rehydration solutions, ritual fluids) and drops or syrups (vitamins, minerals and medicines)	Anything else (in particular, non-human milk, food-based fluids)
Complementary feeding	Breast milk and solid or semi-solid foods	Any food or liquid including non-human milk	
Bottle feeding	Any liquid or semi-solid food from a bottle with nipple/teat	Also allows breast milk by bottle	

Full breastfeeding: the definitions exclusive breastfeeding and predominant breastfeeding together constitute 'full' breastfeeding

Other derivative breastfeeding categories and terms have been subsequently used in the literature including ‘any’ breastfeeding (Ryan *et al.*, 2002; Chien *et al.*, 2005; Li *et al.*, 2005; Xu *et al.*, 2007) and ‘partial’ breastfeeding (Auerbach *et al.*, 1991; Cushing *et al.*, 1998; Lande *et al.*, 2003; Ward *et al.*, 2004; Brekke *et al.*, 2005), which are described below.

Breastfeeding terms consistent with those cited in the literature, including those used in the UK National Infant Feeding Survey, 2000 (Hamlyn *et al.*, 2002)

‘Partial’ breastfeeding: requires that an infant receive some breastfeeds and some artificial feeds, either milk, cereal or other food (WHO/UNICEF*, 1993).

‘Any Breastfeeding’: includes all infants fed human milk or a combination of human milk and formula or cow’s milk.

‘Prevalence of breastfeeding’: refers to the proportion of all sampled infants who were exclusively or partially breastfed at specific ages.

‘Duration of breastfeeding’: refers to the length of time for which breastfeeding continued exclusively, predominantly or partially during the study timeframe.

Breastfeeding ‘initiation’: refers to the proportion of sampled infants who were ‘ever breastfed’ initially post birth (Donath *et al.*, 2000; UK National Infant Feeding Study, 2000; Li *et al.*, 2005) even if mothers attempted to breastfeed only once (Pippins *et al.*, 2006) or if the infant received ‘any breast milk during the hospital stay’ (Merewood *et al.*, 2005). Others define initiation as ‘started breastfeeding within the first hour’ (Pechlivani *et al.*, 2005), first 24-hours (Chandrashekhar *et al.*, 2007) or 48 hours (Giovannini *et al.*, 2004) post birth.

Incidence of breastfeeding: refers to all infants who were breastfed initially i.e. mother put the infant to the breast with the intention of breastfeeding, even if this was on one occasion only, or one isolated event post partum.

* UNICEF denotes the ‘United Nations International Children’s Emergency Fund’

Current evidence cautions that studies examining the effects of breastfeeding on specific well-defined health outcomes need to be particularly vigilant about pre-establishing milk feeding status definitions and limiting ‘loose’ terminology that may lead to methodologically unsound research, fraught with potential confounding issues. For instance, it is important to establish whether the term ‘exclusive breastfeeding’ is interpreted as infants who are ‘exclusively breast milk fed’ or whether infants ‘consume some water in addition to breast milk’. Although by interpretation, the latter definition implies that water does not contribute nutritional value to the milk-feeding regimen, a number of studies indicate that the provision of non-human milk supplements including water or other fluids can affect health outcome for infant mortality (Victora *et al.,* 1989; Kramer *et al.,* 2001) and morbidity in developing (Popkin *et al.,* 1990; Villaplando & Lopez-Alarcon, 2000) and developed countries (Cushing *et al.,* 1998; Raisler *et al.,* 1999; Oddy *et al.,* 2003; Baker *et al.,* 2004) as well as affecting the mother’s risk of ovulation during lactation (Gray *et al.,* 1990). The literature thus suggests that the definition of ‘*exclusive breastfeeding*’ should be used in strict accordance with the WHO definitions.

In addition, the interpretation of ‘partial breastfeeding’ implies varying degrees of breastfeeding input and intensity in that mothers may offer mostly breastfeeds (80% of energy provided by breast milk) and some non-breast milk or solid feeds, or few breastfeeds (20% of energy provided by breast milk) and mostly non-breast milk or solid feeds. Lack of attention and documentation of such subtleties in research can potentially lead to inaccurate interpretations of the true effects of breastfeeding on health outcomes, which may affect policy, or conversely, unjustified optimism and inaction (Cattaneo *et al.,* 2000).

1.1.2.1 Breastfeeding indicators

As a further measure of inter-country breastfeeding monitoring, the WHO (Global Databank on Breastfeeding, 1996) outlined a number of household and health facility indicators to standardise breastfeeding prevalence (%) and duration (months), as well as the prevalence of complementary feeding (%) for use in national and local monitoring programmes (see **Appendix I**). The recommendations advise that the indicators are based on the *'current status data'* notably the current age of the child and other information for the 24 hours preceding the survey, rather than on retrospective data. Aarts *et al.*, (2000) proposed that as well as using 'current status' indicators, which may be inadequate and misleading, studies should also include the indicator '*exclusive breastfeeding since birth*'. However, currently there is no single standard system for data collection being applied across Europe (Promotion of Breastfeeding in Europe, revised 2008).

1.1.3 The benefits of breastfeeding

A host of non-nutritional complex components, although present in small but biologically significant amounts in breast milk, have been indicated as protective anti-infective agents (Prentice, 1996). Two of the major proteins including lactoferrin and secretory-IgA have anti-microbial properties (Prentice *et al.*, 1987), which protect the breast and the infants' gastro-intestinal and respiratory tracts from infection (Weaver & Prentice, 2003) particularly during early lactation. **Appendix II** summarizes some of the protective factors in breast milk with their established functions.

The health, nutritional, immunological, developmental, psychological, social, economic and environmental advantages of breastfeeding are well documented in the literature (AAP, 2005). Breast milk is unequivocally considered to be the optimal food source for the growth and development of the newborn, having major advantages relating to the protection against infections (Campbell, 1996) including neonatal enterocolitis (Golding *et al.,* 1997b) and otitis media (Duncan *et al.,* 1993; Aniansson *et al.,* 1994) as well as the promotion of neuro-development (Morley & Lucas, 1997).

The prophylactic effect of breastfeeding against pathogens such as respiratory syncytial virus, which is a common cause of infant deaths in Western Europe and North America, is especially pertinent (Cunningham *et al.,* 1991). In the wider context, breastfeeding confers significant economical benefits to the health care system (Hoey & Ware, 1997; Weimer, 2001) and parents (Ball & Wright, 1999), particularly in low-income populations (Montgomery & Splett, 1997).

1.1.3.1 Exclusive, predominant, full and partial breastfeeding, versus non-breastfeeding

Studies that incorporated specific breastfeeding definitions including exclusive, full, partial and non-breastfeeding in the study design have found the lowest rates of infection risk and illness among the fully or exclusively breastfed, compared to non-breastfed infants (Popkin *et al.,* 1990; Clemens *et al.,* 1993; Duncan *et al.,* 1993). Such data highlight the importance of using well-defined breastfeeding classifications in detecting positive health effects in infant feeding research.

Cushing *et al.,* (1998) reported that the annualised incidence rates for lower respiratory tract infections were higher among non-breastfed (OR 2.8), compared to partially (OR 2.6) and fully breastfed infants (OR 2.1). Oddy *et al.,* (2003) emphasised that predominant, compared to partial breastfeeding during the first year of life was most protective against the occurrence of respiratory infection and illness associated with hospital admissions. It has also been suggested that the exclusivity of breastfeeding may be central to the mechanism by which breastfeeding protects against later obesity (Singhal & Lanigan, 2007). Furthermore, in an economically and nutritionally disadvantaged setting in Mexico City, Villalpando & Lopez-Alarcon

(2000) found that the duration (number of days) of diarrhoeal illness was shorter among infants who were exclusively, compared to partially breastfed (mean 1.6 versus 3.3 days respectively).

1.1.3.2 Health benefits according to breastfeeding duration

A large body of evidence indicates that the longer mothers breastfeed, the more pronounced and evident the health benefits for both infant (Grummer-Strawn & Mei, 2004) and mother (Dewey *et al.,* 1997; Tryggvadottir *et al.,* 2001). Investigators confirm that breastfeeding duration, even for 3 (Aniansson *et al.,* 1994; Duffy *et al.,* 1997) or 4 (Duncan *et al.,* 1993) months is associated with decreased risk of otitis media in infants. Longer breastfeeding duration ≥ 8 months have also been correlated with higher mean cognitive ability scores at 9 years (Horwood & Fergusson, 1998) while ≥ 16 weeks have been associated with lower risk for Sudden Infant Death Syndrome (Alm *et al.,* 2002). Moreover, several studies have reported a strong dose-dependant inverse association between breastfeeding duration with overweight risk in childhood (von Kries *et al.,* 1999; Hediger *et al.,* 2001; Toschke *et al.,* 2002; Harder *et al.,* 2005).

1.1.4 Health benefits of breastfeeding

1.1.4.1 Protection against acute infectious diseases

Further evidence strongly suggests the protective effects of breastfeeding in preventing infection (Beaudry *et al.,* 1995; Dewey *et al.,* 1995b; Raisler *et al.,* 1999) among infants in the developed world (Howie *et al.,* 1990; Baker *et al.,* 1998) and especially in settings where the climate or living circumstances are unfavourable (Cunningham *et al.,* 1991; Cesar *et al.,* 1999; Villalpando & Lopez-Alarcon 2000; Bhandari *et al.,* 2003). Moreover, Hanson *et al.,* (1992) estimated that the risk of diarrhoea-related death was 23.5 times greater among non-breastfed infants compared to exclusively breastfed infants in developing countries.

Gastro-intestinal illness

The evidence for the protection of breastfeeding against gastroenteritis in both developed and developing settings is particularly robust (Beaudry *et al.,* 1995; Golding *et al.,* 1997a). Landmark research by Howie *et al.,* (1990) in Scotland (n = 674) found that breastfeeding during the first 13 weeks of life conferred protection against gastro intestinal and respiratory illness that persisted beyond the breastfeeding period. Other studies conducted in developed settings have found similar findings (Dewey *et al.,* 1995b; Baker *et al.,* 1998).

Results from a large randomised controlled trial consisting of 16,491 singleton mother-infant pairs in Belarus substantiate the magnitude of the health benefits of breastfeeding reporting a decreased risk of gastro-intestinal tract infection (adjusted OR 0.60, 95% CI 0.4-0.91) and atopic eczema in the first year of life (adjusted OR 0.54, CI 0.31-0.95) among infants who were breastfed (Kramer *et al.,* 2001). Lower risks for the development of necrotizing entercolitis (Lucas & Cole, 1990) and rotavirus infection have also been reported in breastfed infants (Newberg *et al.,* 1998).

Respiratory infection

The marked benefits of breastfeeding against respiratory infection in both developing (Cesar *et al.,* 1999; WHO Collaborative Study in the Prevention of Infant Mortality, 2000; Betran *et al.,* 2001) and developed (Burr *et al.,* 1989; Howie *et al.,* 1990; Cushing *et al.,* 1998) countries are also well documented.

An observational prospective study conducted in Western Australia (n = 2,365) highlighted a strong protective association between predominant and partial breastfeeding against respiratory morbidity (Oddy *et al.,* 2003). Moreover, this study found that hospital, doctor or clinic visits for four or more respiratory tract infections were significantly greater if predominant breastfeeding was stopped before 2 months or partial breastfeeding was stopped before 6-months.

Longitudinal research by Wilson *et al.,* (1998) in Scotland concluded that the probability of respiratory illness occurring during the first 7-years of life was significantly reduced if children were exclusively breastfed for the first 15 weeks post partum. Furthermore, a follow-up study of 8,501 infants in the U.K. (Baker *et al.,* 1998) observed a higher prevalence of wheeze among infants who were never breastfed, with most protection exhibited by breastfeeding ≥ 3 months (OR 0.68, 95% CI 0.59-0.79).

Decreased risk of atopy and asthma

There has been considerable interest in the potential relationship between breastfeeding and protection from the development of allergic disease (Forsyth, 1995) highlighting the presence of anti-inflammatory factors and anti-idotypic antibodies in human breast milk as potential beneficial components (Chandra, 2000). The literature highlights a divergence in opinion with some investigators confirming a protective association (Kull *et al.,* 2002; Zutavern *et al.,* 2004) while others have suggested that breastfeeding is associated with an increased risk of allergy and asthma (Wright *et al.,* 2001; Sears *et al.,* 2002).

Infants with a family history of atopy appear to be most sensitive to the protective effects of breastfeeding (Lucas *et al.,* 1990; Hasan-Arshad, 2001). A meta analysis examining the results of 18 prospective studies found an overall protective effect of exclusive breastfeeding for 3 months on atopic dermatitis (OR 0.68, CI 0.52-0.88), an effect that was strongest in children with a family history of atopy (Gdalevich *et al.,* 2001). Other investigators have found that exclusive breastfeeding during the first 15-weeks (Wilson *et al.,* 1998) and 4-months (Oddy *et al.,* 1999) was associated with a significant decreased risk of childhood asthma development, while up to 6-months (Saarinen & Kajosaari, 1995) has been linked to a decreased prevalence of eczema and food allergy at ages 1 and 3 years. Longer durations of exclusive breastfeeding have been shown to have greatest preventative impact on the development of asthma, suspected allergic rhinitis, atopic dermatitis and suspected allergic respiratory symptoms during the first 2 years of life (Kull *et al.,* 2002).

Overall, regardless of an infant's risk of atopy (AAP, 1997), current consensus among expert groups is that exclusive breastfeeding for 4-6 months (ESPGHAN, 1999; Zeiger, 2003), or if possible, 6-months (AAP, 2000) is strongly recommended as the hallmark for food allergy prevention for all infants.

Improved cognitive development

Several studies have found a positive correlation between breastfeeding and cognitive development (Fergusson & Woodward, 1999) as well as higher intelligence scores (Mortensen *et al.,* 2002) in children and young adults. It has been suggested that these differences may be due to a biological effect of breast milk on later intelligence quotient (IQ), the behavioural effect of mother-infant bonding or to genetic or environmental influences (Fewtrell, 2004). A meta analysis by Anderson *et al.,* (1999) assessed the differences in cognitive development between breast and formula fed children reporting that full breastfeeding particularly among low birth weight infants for 6-months or more, compared to formula feeding, was associated with significantly higher scores for cognitive development. A dose-related relationship between breastfeeding and later IQ has also been documented (Mortensen *et al.,* 2002).

1.1.4.2 Protection against chronic diseases

Inflammatory bowel diseases

Ivarsson *et al.,* (2002) reported that the risk of coeliac disease was reduced in Swedish children aged < 2 years (n = 627) if they were still being breastfed when dietary gluten was introduced (OR 0.59, 95% CI 0.42-0.83). Previous research indicates that breastfeeding provides protection against Crohn's disease (Koletzko *et al.,* 1989; Klement *et al.,* 2004) but not against ulcerative colitis (Koletzko *et al.,* 1991).

In summary, the link between breastfeeding and decreased risk of coeliac disease is unclear (Whorwell *et al.,* 1979) as it is difficult to ascertain whether the association is direct and causal, or indirect through the postponed introduction of infant formula, delayed introduction of gluten (Challacombe *et al.,* 1997) or related to the amount of gluten consumed (Falth-Magnusson *et al.,* 1996).

Diabetes Mellitus

According to Pettitt *et al.,* (1997), exclusive breastfeeding during the first 2-months of life was associated with a lower rate of Type II Diabetes Mellitus among Pima Indians aged between 10-39 years, a population with a particularly high prevalence of the condition.

The protective effects of breastfeeding > 4 months post partum on decreased incidence of Type 1 Diabetes Mellitus in childhood has also been documented (Borch-Johnsen *et al.,* 1984; Schrenzenmeir & Jagla, 2000). In agreement with these findings, a decreased incidence of Type 1 Diabetes Mellitus has been reported in Finnish children who were breastfed until 7-months (OR 0.45, CI 0.24-0.85) post partum (Virtanen *et al.,* 1991). Other investigators in Brazil (Gimeno & de Souza 1997) and the USA (Mayer *et al.,* 1988) have found similar results. However, a recent case controlled study by Visalli *et al.,* (2003) in Italy did not replicate these findings reporting that breastfeeding for less than 3 months, compared to > 3months, was associated with a greater risk of developing Type I diabetes ($p = 0.017$). It has been suggested that more research is needed to elucidate whether breastfeeding is protective against the development of diabetes during childhood or whether the exposure to some component of cow’s milk is a possible pathogenic factor implicated in the aetiology of the condition (Schrenzenmeir & Jagla, 2000).

Cancer

There is some evidence to indicate that breastfeeding may be associated with a significantly reduced risk of acute childhood leukaemia (Shu *et al.,* 1999) and incidence of lymphoma (Davis *et al.,* 1988). A national population-based case-control study conducted in the UK (3,500 cases and 6,964 controls) concluded that there was weak evidence of borderline significance ($p=0.06$) that having been breastfed was associated with a small reduction in the odds ratios for leukaemia (OR 0.89) and for all cancers combined (OR 0.92) (Beral *et al.,* 2001).

Potential 'early programming effect' of breastfeeding on later cardio-vascular risk

Increasingly, research is emerging to indicate a link between early feeding mode and later risk for cardio-vascular disease *via* a potential early 'programming' mechanism (Stanner & Smith, 2005; Rudnicka *et al.,* 2007). Follow-up of 5,471 men in England by Fall *et al.,* (1992) revealed higher mortality ratios for ischaemic heart disease among men who were formula fed compared to those who were breastfed. Singhal *et al.,* (2004) supported experimental evidence for the long-term effects of breast milk feeding on the risk for atherosclerosis, showing that adolescents who had been assigned to receive banked breast milk as infants, had lower C-Reactive Protein concentrations ($p=0.006$) and LDL to HDL ratios than those who were given formula milk ($p=0.04$). There is also an indication that breastfeeding may be associated with increased total and LDL-cholesterol concentrations during infancy, but decreased total and LDL-cholesterol in adult life (Owen *et al.,* 2002) suggesting the possible health effects of breastfeeding on blood lipids throughout life, which may have long term benefits for cardio-vascular health. In contrast to these findings, Leeson *et al.,* (2001) demonstrated that the longer the period of breastfeeding (> 6-months compared to < 1 month), the less distensible the artery wall in early adult life, suggesting that a longer breastfeeding duration is associated with increased cardiovascular risk. The investigators postulated that if breastfeeding is extended throughout infancy (> 6months), the vessel wall may be exposed to raised circulating cholesterol concentrations for longer which may influence arterial changes during later life. However, further work is needed to investigate the effects of early dietary and infant feeding differences on later cardiovascular risk and specifically, on the evolution of arterial disease.

In addition, a systematic review of breastfeeding and blood pressure by Owen *et al.,* (2003) demonstrated a small reduction in systolic blood pressure in breastfed compared to formula-fed children. Similarly, Martin *et al.,* (2004) in the UK found that children at 7.5 years (n = 7,276) who were breastfed as infants, compared to those never breastfed, had decreased systolic (0.8mmHg) and diastolic (0.6mmHg) blood pressures. The investigators concluded that the promotion of breastfeeding is a potential component of the public health strategy to reduce population levels of blood pressure.

Long-term effect on overweight and obesity

It is now well established that childhood obesity has become a global epidemic (WHO, 2003a). Considerable public health interest in the protective effects of breastfeeding on the development of overweight and obesity in childhood and adulthood has increased over recent years. Several population-based studies have confirmed an association between breastfeeding and lower risk of later adiposity (Arenz *et al.,* 2004; Harder *et al.,* 2005; Owen *et al.,* 2005a). Although a number of prominent world experts in the area now contend that breastfeeding represents a potentially ideal window of opportunity for obesity prevention (Gillman, 2002; Singhal & Lanigan, 2007), it has been suggested that the effect of residual confounding in over-representing the actual effect of breastfeeding on the prevention of overweight cannot be ignored (Gillman, 2002; Owen *et al.,* 2005b).

Well-designed studies using large sample sizes, follow-up to pre-school age, with appropriate adjustment for important potential confounding factors suggest a protective effect (OR 0.25 – 0.84) of having been breastfed on later obesity risk (von Kries *et al.,* 1999; Gillman *et al.,* 2001), even in a setting where socio-economic status was reported to be homogenous (Toschke *et al.,* 2002). Such data indicate that the protective effects of breastfeeding on the prevalence of obesity may not be confounded by socio-economic status, and other investigators confirm this finding (Armstrong & Reilly, 2002). Conversely, however, some studies have not replicated these results, concluding that breastfeeding was not associated with adiposity during childhood (Burdette *et al.,* 2006) or with BMI at any stage during adolescence or adulthood (Michels *et al.,* 2007).

Mechanisms for the protective effect of breastfeeding on later overweight risk

A number of putative mechanisms have been postulated for the possible protection of breastfeeding on later overweight risk, including behavioural (Taveras *et al.,* 2004) and hormonal determinants (Agostoni, 2005), along with differences in macronutrient intake (Agostoni *et al.,* 2005). Gillman (2002) suggested that breastfed infants may be better able to communicate their energy needs to the mother, resulting in more appropriate 'self-regulation' of their energy intake in later childhood. The high levels of leptin in breast milk may also play a role in modulating energy balance in breast compared to formula fed infants (Savino & Lupica, 2006). Another mechanism may be related to the differing protein intakes of formula and breastfed infants (Agostoni *et al.,* 2005), which are known to be higher in formula-fed, compared with breastfed infants (Heinig *et al.,* 1993b). The different solid foods introduced to breast and formula-fed infants during the weaning period must also be considered (Dietz, 2001). Infants who are breastfed may be more adapted to the introduction of new foods owing to the increased exposure to different tastes in the breast milk (Sullivan & Birch, 1994; Mannella *et al.,* 2001). Moreover, Skinner *et al.,* (2002b) found that the duration of breastfeeding was a positive predictor of fruit variety intake during childhood.

1.1.4.3 Maternal benefits

Breastfeeding immediately after birth has been reported to promote maternal recovery from childbirth mediated by the infant suckling stimulating the release of the hormone oxytocin into the mother's blood stream (Heinig & Dewey, 1997). Importantly, it has been estimated that enhanced weight loss post partum by an average of 2 kg is achieved if breastfeeding continues for at least 6-months (Dewey *et al.*, 1993), a finding supported by other investigators (Kac *et al.*, 2004).

Several robust studies have indicated an inverse dose-response relationship between the duration of breastfeeding and the risk of breast (Byers *et al.,* 1985; Romieu *et al.,* 1996; Tryggvadottir *et al.,* 2001), ovarian (Whittemore *et al.,* 1992) and endometrial (Rosenblatt & Thomas, 1995) cancers. More recently, a collaborative re-analysis of individual data from 47 epidemiological studies in 30 countries compared women with breast cancer (n = 50, 302) and 96, 973 controls without the disease. The analysis confirmed that 'ever' breastfeeding could account for almost two-thirds of the estimated reduction in breast cancer incidence, the relative risk of breast cancer decreasing by 4.3% ($p<0.0001$) for every 12 months breastfeeding, in addition to a decrease of 7% ($p<0.0001$) for each birth, in both developed and developing countries (Collaborative Group on Hormonal Factors in Breast Cancer, 2002).

Furthermore, exclusive breastfeeding until 6 months has been associated with prolonged amenorrhoea among mothers in Honduras (Dewey *et al.,* 2001) while the probability of pregnancy occurring during lactational amenorrhoea has been shown to be similar to that of other contraceptive methods (Hanson *et al.,* 1992; Kennedy & Visness, 1992) an advantage that is reported to be particularly beneficial in promoting long birth intervals.

1.1.5 WHO (2001) breastfeeding recommendations

Prior to 2001, the WHO (1995) recommended that infants be exclusively breastfed for 4-6 months with the introduction of complementary foods (including any food or liquid other than breast milk) thereafter. However, the optimal duration of exclusive breastfeeding came under technical scrutiny during an expert WHO consultation in 2001. Following an extensive review of the literature, the WHO consultation globally recommended exclusive breastfeeding during the first '6-months of life', with the introduction of solid foods thereafter and continued breastfeeding until 2 years (WHO, 2001). A year later the WHO released a WHO-commissioned systematic review (Kramer & Kakuma, 2002) further supporting and substantiating the evidence for the benefits of exclusive breastfeeding on infant (growth, morbidity, atopic disease, motor development, infant iron status) and maternal outcomes (post partum weight loss and amenorrhea) during the first 6-months, versus exclusive breastfeeding for the first 3-4 months of life. The WHO (2001) recommendation is thus based on extensive evidence-based data in terms of the ability of human milk to meet infant needs during the first 6-months of life, as well as the important role of introducing solid foods at 6-months.

However, there is little doubt that this reviewed global guideline has sparked considerable controversy from experts throughout the scientific, nutrition, medical and public health community worldwide (Garza & Frongillo, 1998; Raiten *et al.,* 2007). The support for, and reported potential concerns with the WHO (2001) recommendation are outlined in **Sections 1.1.5.1** and **1.1.5.2** respectively.

1.1.5.1 Support for the WHO (2001) infant feeding recommendation

Previous studies lend support to delaying the introduction of solid foods until six months including the nutritional sufficiency of breast milk (Cohen *et al.,* 1994), gut immaturity (Hendricks & Badruddin, 1992) and the risk of allergic sensitisation (AAP, 2000; Hasan-Arshad, 2001), without adversely affecting infant appetite or food acceptance (Cohen *et al.,* 1995). Breast fed infants have been shown to self regulate their total energy intake when other foods are introduced indicating a lack of advantage or need to introduce solids prior to 6 months (Cohen *et al.,* 1994). Evidence from two US studies indicated that breast milk intake decreases when solids are introduced between 16-25 weeks (Stuff & Nichols 1989; Heinig *et al.,* 1993a) while the growth of breastfed infants does not appear to be affected by the inclusion of solids (Dewey *et al.,* 1999). Overall, the evidence suggests that breastfed infants have the ability to self-regulate both their breast milk and energy intake from solid foods.

The nutritional adequacy of breast milk

Fleisher-Michaelsen *et al.,* (2000) reported that for the majority of healthy full term infants, a sufficient volume of breast milk from a well-nourished mother should supply the nutrient needs of the infant until about 6 months of age. Kramer & Kakuma (2002) supported the view that exclusive breastfeeding during the first six months is nutritionally adequate and safe for most babies providing the mother is well nourished. Mean intakes of human milk have been shown to provide sufficient energy and protein to meet the requirements of full-term breast fed infants during the first 6 months of infancy (Butte *et al.,* 2002). Moreover, some investigators have shown that exclusive breastfeeding during the first 6-months does not lead to growth faltering in developing settings (Dewey *et al.,* 1999; Bhandari *et al.,* 2003). Beyond 6-months however, once the infants' prenatal iron stores are exhausted (Wharf *et al.,* 1997), exclusively breastfed infants are likely to become deficient in iron unless an exogenous food source is provided (Butte *et al.,* 2002).

1.1.5.2 Potential and reported issues of concern with the WHO (2001) recommendation

It is undisputed that prolonged and exclusive breastfeeding beyond 6 months confers benefit in terms of the infant's health and development in nutritionally vulnerable settings (Adair *et al.,* 1993; Onyango *et al.,* 1999). However questions have been raised as regards the relevance and application of the guideline in developed countries (Foote & Marriot, 2003). The benefits of exclusive breastfeeding are particularly emphasised in developing countries where sanitation is poor and the risks of contamination as a result of introducing solid foods are greater than the potential benefits (Golding *et al.,* 1997a). Moreover, the microbial burden from bottle-feeding can be substantial, and the resulting diarrhoeal illness is easiest to avoid when a baby is breast-fed (Cunningham *et al.,* 1991). Further advantages of exclusive breastfeeding in these settings relate to the maximal intakes of human milk, lengthened duration of post partum amenorrhea and hence prolongation of birth intervals (Frongillo & Habicht, 1997). However, in most developed countries, uncontaminated, nutritionally adequate complementary foods are readily available, and growth faltering is relatively uncommon (Kramer *et al.,* 2003). It has been argued that the conduct of studies in developing countries are only representative of a specific population, which provide insufficient evidence to support exclusive breastfeeding during the first 6-months of life in the global context (Lanigan *et al.,* 2001). It has also been pointed out that some sub-groups, such as low birth weight infants, may require early supplemental feeding (< 6 months) (Lanigan *et al.,* 2001), while infant-related factors may also influence the infant's nutritional requirements during the first year of life including birth weight, maturity, rate of post natal growth and infectious illness (Krebs & Hambridge, 2007). Some investigators in the UK have challenged the sufficiency of breast milk provision by some mothers to feed a 6-month old adequately, suggesting that exclusive breastfeeding would supply only 90% of the infant energy requirements at age 6-months (Reilly & Wells, 2005).

Nutrients that may be sub-optimal in breast milk

While it is widely acknowledged that iron deficiency remains a problem in older infants and toddlers (Lawson *et al.,* 1998), zinc (Gibson, 1994) and vitamin D (Lawson & Thomas, 1999) deficiencies are also common. Regardless of socio-economic status, vitamin D supplementation is suggested to be particularly important for growing children as well as for pregnant and lactating women when their exposure to sunshine is limited (Mughal *et al.,* 1999). Indeed, recently the Food Safety Authority of Ireland (FSAI, 2007) recommended that all infants, irrespective of how they are fed, should be given a daily vitamin D supplement (200 IU/5μg/day) from birth to 12 months of age.

Although there is some evidence to support that longer breastfeeding duration (≥ 7 months) may decrease the risks of anaemia (Pisacane *et al.*, 1995), by 6-months the iron (Dewey *et al.,* 1998) and zinc levels in human milk are unlikely to meet infant requirements without contributions from solid foods (AAP, 2004). Moreover, in certain populations deficient in vitamin A (Panpanich *et al.,* 2002), vitamin D (Ahmed *et al.,* 1995), zinc (Gross *et al.,* 1998; Kaur *et al.,* 2002), B_{12} (Renault *et al.,* 1999) and B_6, the amount of these nutrients in human milk in the first 6-months of life may be sub-optimal (Butte *et al.,* 2002). It has also been established that the concentration of zinc in breast milk declines sharply in the first few months of lactation, independent of maternal zinc intake (Krebs *et al.,* 1995), even among upper middle class women (Gross *et al.,* 1998).

Regardless of the conflicting opinions about the optimal timing of exclusive breastfeeding, it has been acknowledged that the WHO (2001) recommendation is intentionally a 'global one', relating to optimal feeding for 'all' infants, regardless of their environment (Fewtrell *et al.,* 2007). Subsequently, in May 2003 the Department of Health (UK) endorsed this recommendation for all infants and this was further supported by the UK Sub Group on Maternal and Child Nutrition (2003) and the British Dietetic Association (BDA) Paediatric Group (2004).

1.1.5.3 Irish breastfeeding recommendations

In line with the WHO (2001) revised recommendation, Irish feeding guidelines were changed from the previous 'exclusive breastfeeding for 4-6 months' (FSAI, 1999) to 'exclusive breastfeeding for 6-months/26-weeks', with the encouragement of continued breastfeeding until 2 years, in combination with appropriate complementary solids (Department of Health and Children Policy Change in Infant Feeding, 2003). This revised guideline, supported by a number of Irish expert institutions and organisations[*] was advised as a public health recommendation aimed at the whole population. However, the importance of considering both mother's and infant's nutrition and *'the assessment of the individual needs of infants, particularly if they are from an at-risk group'* including pre-term, intra uterine growth retardation, slow infant weight gain and those who are feeding poorly was acknowledged.

[*] The Health Promotion Unit, The Institute of Obstetricians and Gynaecologists, The Faculty of Paediatrics, La Leche League of Ireland, The Midwifery Forum, The Irish Nutrition and Dietetics Institute, The Irish College of General Practitioners, Ciudu-Irish Childbirth Trust, The Association of Lactation Consultants in Ireland, The Institute of Community Health Nursing

1.1.6 Irish breastfeeding rates: the historical perspective

Historically, it has been well recognised that Irish breastfeeding initiation and duration rates have remained strikingly low in comparison to international figures. A pan-European study (‘Euro-Growth Study’ 1992-1996) examining the infant feeding practices of 22 countries in Europe confirmed that Irish breastfeeding rates were among the lowest in Europe with only 26% of mothers in Dublin offering ‘any’ breast milk to their infants at 4-weeks in comparison to 94% in Budapest (Hungary), 94% in Umea (Sweden) and 99% in Athens (Greece) (Freeman, 1996). Moreover, the incidence and exclusive breastfeeding rates upon discharge from the maternity hospitals are particularly low among lower socio-economic groups (Hurley & Fogarty, 1992; Loh *et al.*, 1997). Even more recently, the 2004 National Perinatal Statistics indicates that 68% of mothers from higher professional occupations breastfed at hospital discharge compared to only 25% from semi-skilled manual occupations. It is also a cause for concern that the data indicate a sharp fall in breastfeeding rates once mothers leave the maternity hospital with few mothers reported to offer any breast milk to their infants at 6-weeks (20%) (Howell *et al.*, 1996) and 12-weeks (16%) (Twomey *et al.*, 2000). While there is a lack of documented breastfeeding duration rates as defined by clear breastfeeding definitions in Irish research, the few existing studies that have examined duration rates indicate that the proportion of infants reported to be exclusively breastfed during the first six months are most certainly among the minority (see **Table 1.2**).

Table 1.2. National breastfeeding rates 1974 – 2004 (see footnote for abbreviation explanations)

Authors	n	Study details	Initiation (%)	Discharge from Hospital (%)	4 wks (%)	6 wks (%)	12 wks (%)	16 wks (%)	6 mnths (%)
Kalapesi & Kevany (1974)	551	Rotunda Hospital, Dublin (1969-1970)	11						
Kevany *et al.*, (1975)	198	4 Dublin maternity hospitals including: St. James's Hospital, National Maternity, Coombe and Rotunda	16						
O'Herlihy (1978)**	675	Child clinics in 3 Dublin areas	42			30.5	23		13
Joyce *et al.*, (1978)**	1,193	Rotunda Hospital, Dublin (all live born infants born from Jan 1979-Dec 1980)	19			11			
Gillmore *et al.*, (1978)	111	Wexford maternity hospital (all mothers attending 2 ante natal clinics over a 3-month period)	24						
Connolly *et al.*, (1981)	143	National Maternity Hospital, Dublin (all mothers who gave birth over a 14-day period)	45						
McSweeney & Kevany, (1982) ^	1,195	**Nationally representative sample: (incorporated 31 maternity units across Ireland)**		32 AB (29 EB & 3PB)		21 AB 16 EB	11 AB 7 EB		5 AB <1 EB
Joyce *et al.*, (1984)**	12,530	Rotunda Hospital, Dublin	35			19			
McSweeney (1986) ^	1,067	**Nationally representative sample (incorporated 32 hospitals in Ireland)**		34 AB (31 EB)		23 AB	14 AB		
Hurley & Fogarty, (1992)**	218	Regional research: recruitment site not specified (mean duration of breastfeeding: 6-weeks)		49			17		5 (5mnt)
Lowry & Lillis, (1993)**	877	University College Hospital, Galway	36	33					10 (5mnt)
Fitzpatrick *et al.*, (1994)	200	Rotunda Hospital, Dublin	39.5						
Sayers *et al.*, (1995)**	145	Co. Kildare (all babies born in May 1993)	38	32		23	13		

**study reports a 'breastfeeding rate' <u>but does not include specific breastfeeding definitions</u>
^ indicates the 'nationally representative studies'
wks denotes 'weeks' mnths and mnt, denote 'months'

AB denotes the 'any breastfeeding rate'
EB denotes the 'exclusive breastfeeding rate'
PB denotes the 'partial breastfeeding rate'

Table 1.2 continued: National breastfeeding rates 1974 – 2004

Authors	n	Study details	Initiation (%)	Discharge from Hospital (%)	4 wks (%)	6 wks (%)	12 wks (%)	16 wks (%)	6 mnths (%)
Howell *et al.,* (1996)**	287	All singleton births recruited in a 4-week period in the north east region of Ireland	35	30		20		10	
Freeman (1996)	121	Longitudinal, prospective study: Coombe Women's Hospital, Dublin			26 AB 18 EB		18 AB		
Ward (1996)**	76	Rotunda Hospital Survey, Dublin (all babies born in April 1996)	34					5	
Loh *et al.,* (1997)**	193	Biased towards the lower socio-economic groups Intervention study: University College Hospital, Galway Randomized prospective sample		31.5 CG 44 TG	18 CG 29 TG				
Mid-Western Health Board Survey (1997)	339	All mothers resident in the mid-western region were invited to participate (April-May 1997)	34	30 AB		22 AB		13 AB	6 AB 7-9mo
Twomey *et al,* (2000) **	197	Randomly selected infants from the 'birth register' of the Eastern Health Board	51		30	28	16	10	8
SLAN National Survey (2003) ^	5,992	**Nationally representative sample: cross-section of Irish population** **Rates resemble the number of mothers who reported to breastfeed 'any of their children'**		mothers who breastfed any child: 37					
Ward *et al.,* (2004)	247	North Eastern Health Board study (Jan-Feb 2003) Over representation of higher socio-economic groups	51			18 EB 13 PB	13 EB at 14-wks		

**study reports a 'breastfeeding rate' but <u>does not include specific breastfeeding definitions</u>
^ indicates the 'nationally representative studies'
AB denotes the 'any breastfeeding rate'
PB denotes the 'partial breastfeeding rate
EB denotes the 'exclusive breastfeeding rate'
wks denotes 'weeks' mnths and mo, denote 'months'

CG denotes the study 'control group'
TG denotes the study 'test group'

Note: percentages were rounded up (>0.5%) or down (<0.5%)

1.1.6.1 Breastfeeding data in Ireland: a need for updated comprehensive research

It is well recognised and widely acknowledged that limited high quality breastfeeding and infant feeding data exist in Ireland (National Breastfeeding Policy for Ireland, 1994; FSAI, 1999). Although regional studies have been conducted to examine breastfeeding rates and the issues surrounding breastfeeding during the last thirty years, many of these studies have been criticised for the small sample sizes recruited and variation in the infant ages at follow-up (Fitzpatrick & Kevany, 1977) as well as being potentially biased towards selected participants or mothers of higher socio-economic status (O'Herlihy, 1978; Hurley & Fogarty, 1992; FSAI, 1999). Moreover, several studies have not specified the definition of breastfeeding (O'Herlihy, 1978; Lowry & Lillis, 1993; Sayers *et al.,* 1995; Loh *et al.,* 1997) making interpretation of the reported 'breastfeeding rates' difficult to compare. Incomplete data collection has been acknowledged as a limitation in other regional studies (Joyce *et al.,* 1978). The exclusion of non-national mothers and asylum-seekers owing to difficulties in following up these groups has also featured in more recent Irish infant feeding research (Ward *et al.,* 2004).

The Interim Report of the National Breastfeeding Committee (2003) acknowledged that the National Perinatal Statistics are a good data source, presenting the only national monitoring system for the collection of feeding status at the point of hospital discharge. However, a two year interval between the collection and publication of reports has been criticized for being overly long and hence, their effectiveness as a dynamic evaluative tool is somewhat reduced.

Breastfeeding trends through the decades

As far back as 1974, Kalapesi & Kevany (1974) reported a breastfeeding initiation rate of 11% in the Rotunda Hospital in Dublin (n = 551), while Kevany *et al.*, (1975) in a smaller multi-centred study (n = 198) incorporating mothers who gave birth from one of four Dublin maternity hospitals reported an initiation rate of 16%. A low initiation rate of 24% was also found in a regional study based in Wexford, with the investigators concluding that artificial feeding had become an 'accepted feature of life' (Gillmore *et al.*, 1978).

During the 1980's, two nationally representative infant feeding studies were conducted, in 1982 (McSweeney & Kevany, 1982) and 1986 (McSweeney, 1986), reporting 'any' breastfeeding rates of 32% and 34% respectively at discharge from the maternity hospital, with similar (35%)(Joyce *et al.*, 1984) and slightly higher rates (45%)(Connolly *et al.*, 1981) reported in other studies during that decade. Indeed Kevany *et al.*, (1975) reported that formula feeding had risen from 35% to 78% in one generation and a later study remarked that artificial feeding had become the predominant feeding method for infants in Ireland during the 1980's (Joyce *et al.*, 1984).

Further evidence indicates that there may be wide geographical variation in terms of breastfeeding initiation both internationally (Dulon *et al.*, 2001; Ryan *et al.*, 2002; Chien *et al.*, 2005) and in Ireland. As far back as 1986, (McSweeney, 1986) the highest breastfeeding rates were observed in the Dublin maternity hospitals (43%) while no mother was reported to have breastfed in Carlow or Dundalk. More recently, the Mid-Western Health Board 1997 survey reported the lowest breastfeeding initiation rate in Newcastle West in Co. Limerick (18.5%) compared to higher rates found in Ennis in Co. Clare (46%) and the North Clare region (53%). A North Eastern Health Board survey (1996) highlighted that higher breastfeeding initiation rates were observed in Co.

Meath (44%) in comparison with Co. Cavan/Monaghan (29%), and at 16-weeks the trends continued, with 17% and 9% of mothers breastfeeding in the two regions respectively (Howell *et al.*, 1996).

Even within the confines of the north inner city in Dublin, a small study (n = 76) undertaken by the Rotunda Hospital reported that in Ballymun, a known socio-economically disadvantaged area in north Dublin, 16% of mothers initiated breastfeeding while in more socio-economically thriving areas of Millmount (100%) and Larkhill (100%) all mothers were reported to have initiated breastfeeding (Ward, 1996). This survey did not document the sample sizes of the mothers living in these regions; however, it highlighted the socio-economic and geographical divide in breastfeeding rates within North Dublin. Similarly, Hurley & Fogarty (1992) reported that breastfeeding rates were lower among mothers in the inner city (22%) compared with those living in the outer suburbs (56%).

In the south east of Ireland, the South Eastern Health Board indicated that the initiation rates in the region were lower in comparison to the national rate with a considerable decline in rates following hospital discharge and between 4-6 weeks post partum (Fennessy, 1999). In agreement with this observation, a cross-sectional national health survey (n = 5, 992) (SLAN, 2003) recorded the number of mothers who reported to breastfeed ‘any’ of their children, revealing the lowest rates in the South Eastern (30%) and the North Western (33%) parts of Ireland, compared to higher rates recorded in the East Coast Area (41%) and the Western region (42%). Although this study aimed to collect information on the general health behaviours of a representative sample of the population and was not designed as a infant feeding study, these data are still valuable and add to a body of evidence that may suggest higher breastfeeding rates in the east, west and mid-west and lower rates in the south east and north west of Ireland.

Inter-country differences in breastfeeding rates have also been reported in the UK with higher breastfeeding rates reported in England and Wales (71%) compared with Northern Ireland (54%) (UK National Infant Feeding 2000 Survey).

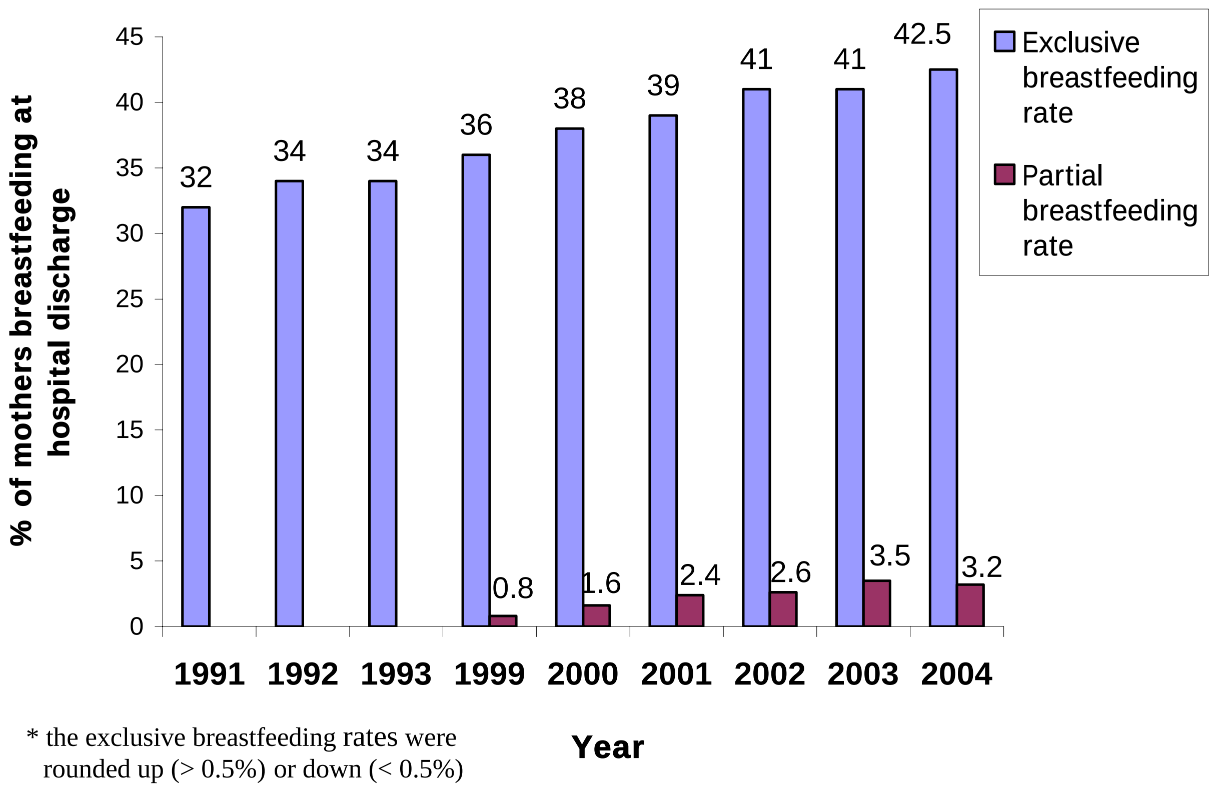
1.1.6.2 National Breastfeeding Policy for Ireland (1994)

In recognition of the potential barriers to breastfeeding in Ireland, and in an effort to increase the uptake and duration of the practice, the National Breastfeeding Policy for Ireland was published by the Department of Health in 1994. The policy recommendations related to four key areas for action: 'in-hospital', 'community', 'training of health professionals' and the 'wider-community perspectives', the details of which are summarized in **Appendix III**.

Furthermore, the 1994 policy set breastfeeding targets, including an overall breastfeeding initiation rate of 35% by 1996, 50% by the year 2000 and an initiation rate of 20% among lower socio-economic groups by 1996 and 30% by the year 2000. In addition, the policy aimed to achieve a breastfeeding rate of 30% at four months by the year 2000.

During the intervening years, some regional infant feeding studies were carried out in Co. Kildare (Sayers *et al.,* 1995), Galway (Loh *et al.,* 1997) and Dublin (Ward *et al.,* 2004) and highlighted the continual lack of improvement in breastfeeding initiation rates. The National Perinatal Statistics (1985-2004) represent the only national monitoring of exclusive breastfeeding rates (expressed as a proportion of all newborn infants) at the point of discharge from the maternity hospital, unit or those under domiciliary midwife care in Ireland, the data from which are published every two years in the National Perinatal Statistics Report. From 1999, information on exclusive and partial breastfeeding rates has been included in the data collection system, and from January 1st 2003 strict use of the definition of exclusive breastfeeding in accordance with the WHO guidelines (see **Table 1.1**) was emphasised. It is noteworthy that the breastfeeding rates reflect only the proportion of mothers exclusively or partially breastfeeding ‘upon discharge from the maternity hospital’ and there is no other official national mandatory collection or documentation of initiation or other breastfeeding duration rates in Ireland. As illustrated in **Figure 1.2**, the exclusive breastfeeding rates remain consistently low with only 38% of mothers exclusively breastfeeding upon discharge from the maternity hospital in 2000, far from the achievement of the 50% breastfeeding target set up in the 1994 policy. However, more optimistically, a modest positive trend is observed, indicating that the breastfeeding rates are improving by an average of 1% per year.

Figure 1.2. Selected National Perinatal Statistics from 1991 to 2004



* the exclusive breastfeeding rates were rounded up (> 0.5%) or down (< 0.5%)

National Performance Indicators

In 2002, National Performance Indicators were devised as an interim standard template for a quarterly submission to the Department of Health from each health board in Ireland. The set Performance Indicators included the percentage of infants:

- 'Exclusively' breastfed at discharge from the maternity hospital/unit
- 'Partially' breastfed at discharge from the maternity hospital/unit
- 'Exclusively' breastfed at 3-months post partum
- 'Partially' breastfed at 3-months post partum

The National Working Group on Child & Adolescent Health Performance Indicators (June, 2004) emphasised a specific focus on the collection of accurate comprehensive breastfeeding rates at hospital discharge. It was proposed that the 3-month breastfeeding rates would be collected by the public health nurses (PHNs) by conducting a '24-hour recall' on the infant's food and fluid intake at the time of the routine 3-month developmental check-up. However while the collection of the 3-month rates has been advised among all Health Boards in Ireland as being ideal practice, it is not being enforced as a 'mandatory' infant feeding monitoring system and, to date, no data have been published on these rates. Moreover, difficulties have been reported in collecting manual data from large numbers of PHNs (Interim Report of the National Committee on Breastfeeding, 2003).

1.1.6.3 Interim Report of the National Committee on Breastfeeding, 2003

In 2003, an expert group reviewed the degree to which the 1994 policy recommendations had been implemented, reporting that most improvement and progress was achieved in the in-hospital maternity setting (Interim Report of the National Committee on Breastfeeding, 2003).

As a direct result of the advancements enabled by the 1994 National Breastfeeding Policy, the 2003 Interim report highlighted that the vast majority of hospitals in Ireland have adopted the WHO/UNICEF (1989) research-based *'10 Steps to Successful Breastfeeding'* (see **Appendix IV)** and were found to be participating in the 'Baby Friendly Hospital Initiative' (BFHI) on which the WHO/UNICEF (1989) recommendations are based. The BFHI is a global campaign that aims to promote best practice in the maternity service with a view to promoting breastfeeding. Following a formal BFHI external assessment, a maternity hospital that achieves full 'BFHI status' has displayed a commitment to the successful implementation of the WHO/UNICEF criteria outlined in **Appendix IV**, in addition to the lack of acceptance of low cost or free breast milk substitutes, feeding bottles and teats. Alternatively, based on the extent of a hospital's commitment to the BFHI recommendations, the hospital is awarded a 'Certificate of Commitment' or 'Membership' to BFHI. There are currently 20 maternity units/hospitals in Ireland, 19 of which participate in the BFHI. To date, 7 maternity hospitals in Ireland have achieved the National BFHI award including Portiuncula Hospital, Galway (2004), Waterford Regional Hospital (2004), St. Munchin's Maternity Hospital in Limerick (2004) and more recently Our Lady of Lourdes Hospital in Drogheda (2007), The Rotunda Hospital in Dublin, University College Hospital, Galway and Caven General Hospital. Moreover, most hospitals have appointed Clinical Midwife Breastfeeding Specialists, and a National Breastfeeding Co-Coordinator has also been appointed.

The 2003 review indicated that a number of local and regional breastfeeding policies had been drawn up for the majority of health boards and hospitals. Improvements were also observed in the number of health-professionals who received breastfeeding education. Recommendations covering the community-care settings revealed less progress however, with no appointment to date of Regional Breastfeeding Co-ordinators with dedicated time to provide breastfeeding education and support to mothers in the community. Thus the objectives and recommendations relating to the wider community were not achieved; an area that was highlighted as requiring greatest input and that represented significant support for mothers.

Five-Year Strategic Action Plan (2005)

To further address the consistently low breastfeeding rates during the 1990s and 2000's, the National Breastfeeding Committee devised and published a Strategic Action Plan (Department of Health and Children, 2005) representing a step forward in the development of a breastfeeding-supportive culture in Ireland. This national action plan set out time-framed breastfeeding targets, including the increase of breastfeeding initiation by at least 2% per year, and by 4% per year for lower socio-economic groups, with the monitoring of rates recommended between 3-4 months, 6 months and at one-year post partum. The development of a comprehensive, accurate and timely infant feeding data collection system was outlined as being a key target for the strategy with possible implementation by the end of 2006, as part of an overall child health information system. However to date, this national infant feeding monitoring system has not been implemented. It was suggested that national monitoring and assessment of breastfeeding would include 'exclusive' and 'partial' breastfeeding definitions, in accordance with the WHO definitions. Finally, the five-year plan sought to achieve at least 50% of hospital births to take place in nationally designated BFHI hospitals, with

100% participation in the BFHI initiative among all maternity hospitals, as well as the increased appointment of Breastfeeding Co-ordinators with a defined regional responsibility.

1.1.6.4 Promotion of breastfeeding in Europe: a blueprint for action (revised 2008)

Launched in Dublin Castle at an EU conference in 2004, and further revised in 2008 (unpublished), 'Blueprint for Action' is a model plan that provides a framework for the development of initiatives aimed to protect and support breastfeeding within Europe. Effective policy and planning, as well as timely evaluation and monitoring of all initiatives was central to the action plan. The project was approved and funded by the European Commission and was implemented in May 2005 in eight European countries including Belgium, Denmark, France (Rhone-Alpes), Italy (Tuscany), Latvia, Luxemburg, Poland (Lublin) and Ireland.

In order to achieve effective and optimal promotion and protection of breastfeeding across Europe, six core components were recommended in the 'Blueprint for Action', which proposed and outlined the tentative content of a national plan, as described below.

1.) Policy and planning recommended the implementation of a national policy based on the Global Strategy on Infant and Young Child Feeding (WHO 55th World Assembly, 2002), in addition to the designation of suitably qualified co-ordinators.

2.) Communication for behaviour and social change advised that communication for behaviour and social change messages for individuals and communities remains consistent with policies, recommendations and laws within the health and social services sector. The continual restriction of the distribution of marketing materials on infant feeding provided by manufacturers and distributors of products under the scope of the International Code of Marketing was also emphasised.

3.) Training of health professionals: Pre- and in-service training for all health worker groups was underscored as requiring improvement.

4.) Protection, promotion and support of breastfeeding: Emphasised the importance of effective support for all breastfeeding mothers in maternity and child care services and encouraged the continual promotion of breastfeeding as the cultural 'norm'.

5.) Monitoring: A crucial component of the Blueprint for Action is the high priority afforded to monitoring and evaluating the implemented procedures and practices of health and social services. An integral part of the plan urges the use of standardised indicators, breastfeeding definitions and methods in monitoring breastfeeding initiation and duration rates, as well as exclusivity.

6.) Research: The plan outlined the need for the conduct of quality research with regard to study design, adequate sample sizes, research methods, consistency in the use of standard infant feeding definitions and appropriate use of qualitative methods.

1.1.6.5 Irish versus international breastfeeding rates

The literature indicates that vast differences exist in breastfeeding prevalence both within (Riva *et al.,* 1999; Dulon *et al.,* 2001) and between European countries (Yngve & Sjostrom, 2001a). Irish breastfeeding rates (see **Table 1.2**) fall markedly short compared with other countries (see **Table 1.3**), however the exclusive breastfeeding rate at six months appears low throughout Europe. Although national infant feeding studies have not been carried out in Ireland over the last 20 years, recent regional Irish studies report initiation rates of 51% (Twomey *et al.,* 2000; Ward *et al.,* 2004) which are higher than those reported in the National Perinatal Statistics (2004)(42.5%). Higher initiation rates have been documented in large international longitudinal studies including 69% in the UK (Hamlyn *et al.,* 2002), 69.5% in the USA (Ryan *et al.,* 2002), 88% in Australia (Scott *et al.,* 2001), 97% in Switzerland (Merten &

Ackermann-Liebrich, 2004) and 99% in Norway (Lande *et al.*, 2003). In the international perspective, the frequency of breastfeeding in Sweden is high with 98% of infants born in 2004 reported to have been exclusively breastfed at 1 week and more than 91% of infants were exclusively or partially breastfed at 2-months (Swedish National Board of Health and Welfare). While most mothers cease breastfeeding between 6-12 months in the USA (Dennis, 2002) and Australia (Scott *et al.*, 2001), it appears that most Irish mothers discontinue breastfeeding between hospital discharge and 6-weeks post partum.

Moreover, in contrast with Ireland, international research suggests a heavy public health and government investment on ensuring up to date monitoring and documentation of infant feeding practices which allows the assessment of changes in feeding trends over time. Robust, well-designed longitudinal infant feeding studies (Xu *et al.*, 2007) reporting high response rates (Riva *et al.*, 1999), consisting of large sample sizes (Pontin *et al.*, 2007) incorporating representative (Foster *et al.*, 1997) and nation-wide populations (Lande *et al.*, 2003) that used clearly defined breastfeeding definitions (Giovannini *et al.*, 2004) and report standardised infant ages at follow-up (Xu *et al.*, 2007) are common features of international infant feeding research. However, in order to meet these high-quality methodological standards in Ireland, greater effort and investment is required, with support from the government and health boards being pivotal to the implementation of a prospective national breastfeeding monitoring system. Published data from local and regional research over the latter decade are also lacking in Ireland. In fact, it could be argued that more in-depth research on breastfeeding practices was conducted in the 1980s in Ireland, which saw the completion of two nationally representative studies, in comparison with more recent years.

Table 1.3. Selected international studies reporting on breastfeeding rates (see footnote for abbreviation explanations)

Authors	**n**	**Study details**	**Initiation (%)**	**Discharge from hospital (%)**	**4 wks (%)**	**6 wks (%)**	**8 wks (%)**	**12 wks (%)**	**16 wks (%)**	**20 wks (%)**	**6 months (%)**
Bouvier & Rougemont, (1998)	278	Random sample of mothers in Geneva	93 AB [$] 87 EB/Pred. [$]					62.5 AB 37.5 Pred.	51 AB 19 Pred.		28 AB 4 Pred.
Hornell *et al.*, (1999)	506	Prospective, longitudinal study Uppsala in Sweden	100				68 EB		40 EB		2EB
Ryan *et al.*, (2002)	1.4 million	USA National ‘Mothers’ Survey	69.5 AB[$] 46 EB[$]								32.5 AB 17.2 EB
Hamlyn *et al.*, (2002)	9,500	National Feeding Study UK	69			42 AB			28 AB		21 AB
Lande *et al.*, (2003)	3,000	Nation wide sample of Norwegian infants	99		96 AB 90 EB	95 AB 87 EB	92 AB 81 EB	88 AB 70 EB	85 AB 44 EB	82 AB 18 EB	80 AB 7 EB
Giovannini *et al.*, (2004)	2,450	Epidemiological study in Italy (1999-2000)	91	77 EB 1 Pred. 11 PB	57 EB 5 Pred. 19.5 PB		52 EB 2.5 Pred. 17.5 PB	47 EB 1 Pred. 17 PB	31 EB 1 Pred. 26.5 PB	20 EB 0.5 Pred. 33.5 PB	4.7 EB 0.3 Pred. 42 PB
Brekke *et al.*, (2005)	11, 081	1-year follow-up of infants in the ABIS Swedish study *						78 EB 88 PB	85 PB		10 EB 69 PB
Lanting *et al.*, (2005)	9,133	Recruitment of Dutch infants: 238 baby clinics in Holland	78		51 Pred. 11 PB		37 Pred. 14 PB	30 Pred. 13 PB	25 Pred. 14 PB	19 Pred. 14 PB	15 Pred. 18 PB
Li *et al.*, (2005)	3,444	A component of the USA National Immunization Survey	71.4		63 AB 57 EB		57 AB 49 EB	51.5 AB 42.5 EB	44 AB 31 EB	39 AB 19 EB	35 AB 13 EB
Donath & Amir, (2005)	1,883	2001 Australian National Health Survey		83 FB				57 FB 64 PB&FB			18FB 49PB&FB
Chien *et al.*, (2005)	2,079	National study, Taiwan	65	18 EB, 47 PB	22EB 48 PB			17 EB 17 PB			
Bakoula *et al.*, (2007)	3,734	Greece Birth longitudinal study						52 AB 37 EB			24 AB 17 EB
Pontin *et al.*, (2007)	11,490	Longitudinal & representative study in the UK			55 EB 1 Pred.		44 EB 2 Pred.	31 EB 2.5 Pred.	10 EB 1 Pred.	1.6 EB 0.3 Pred.	0.4 EB 0.1 Pred.
Xu *et al.*, (2007)	1,219	Longitudinal study in Xinjiang AR region in China		92 AB 66 EB		90 AB 30 EB					73 AB 6 EB
Chandrashekhar *et al.*, (2007)	385	Cross sectional survey in western Nepal	84				82 EB				

[$] denotes the ‘in-hospital’ breastfeeding rate
* ABIS denotes ‘All Babies in Southeast Sweden study’

wks denotes ‘weeks’

AB denotes the ‘any breastfeeding rate’ FB denotes the ‘full breastfeeding rate’
EB denotes the ‘exclusive breastfeeding rate’
PB denotes the ‘partial breastfeeding rate’
‘Pred’ indicates the ‘predominant breastfeeding rate’

1.1.7 Factors determining breastfeeding initiation

Infant feeding investigators emphasise that breastfeeding practice is multifactorial in nature (Chandrashekhar *et al.*, 2007). The determinants of a mother initiating breastfeeding hinge upon several diverse factors including socio-demographic, infant characteristics, ethnicity, mother's support network, as well as maternal attitudes to breastfeeding and the confidence within herself in being able to breastfeed. **Figure 1.3** illustrates a multi-dimensional '*a priori* model', adapted from work by Mayerink & Marquis (2002) which presents a host of commonly documented factors associated with breastfeeding initiation and duration, from which many individual breastfeeding determinants in the literature are extrapolated.

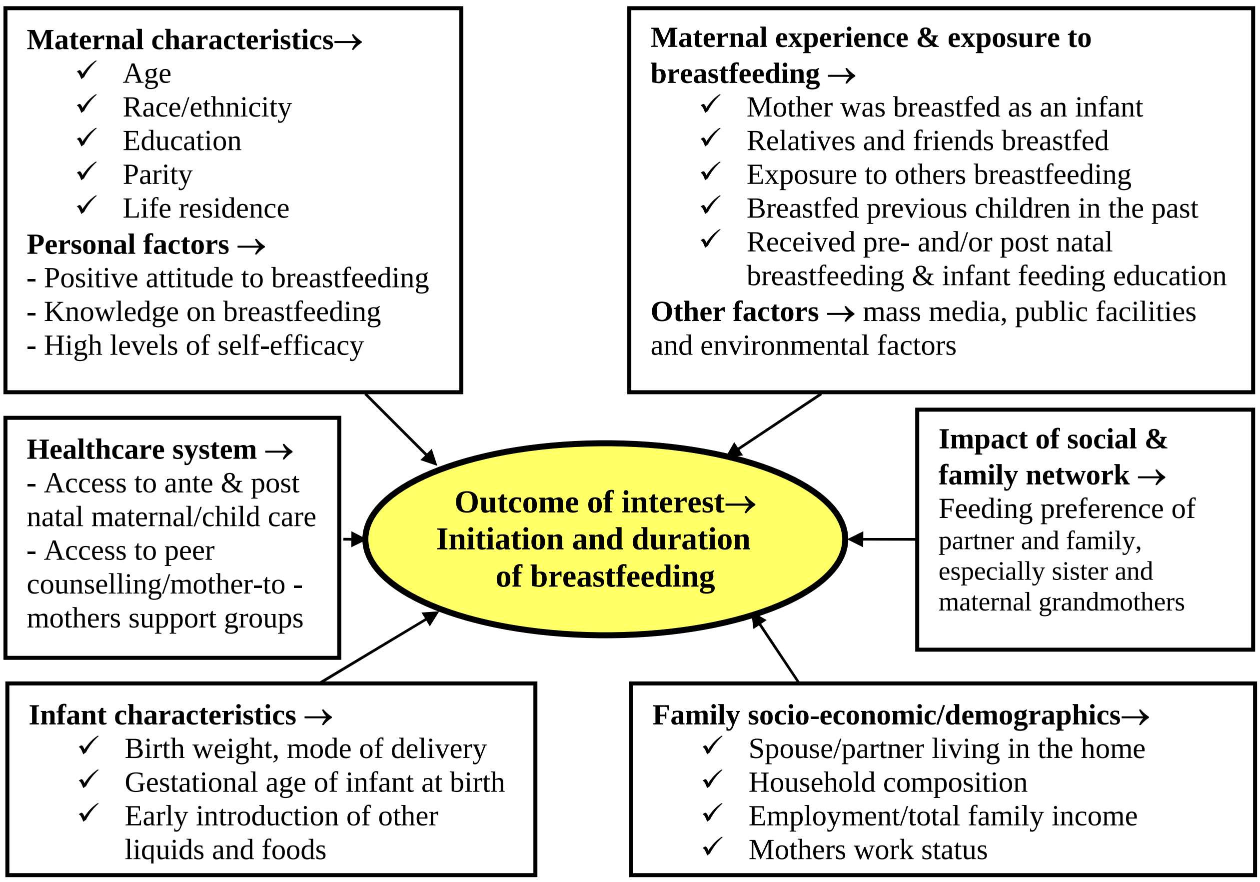


Figure 1.3. ***A priori*** **model developed from published literature showing the breastfeeding outcomes and their proposed determinants, adapted from Meyerink & Marquis (2002)**

1.1.7.1 Socio-economic factors

Considerable evidence suggests that mothers who initiate breastfeeding are more likely to be from a higher socio-economic status (Sayers *et al.*, 1995; Sloan *et al.*, 2006), be well-educated (Hamlyn *et al.*, 2002; Li *et al.*, 2004), married (Twomey *et al.*, 2000), older (Fitzpatrick *et al.*, 1994), non-smokers (England *et al.*, 2003), attend ante natal classes (Noble *et al.*, 2001), have friends or family with previous breastfeeding experience and have breastfed previous children (Ward *et al.*, 2004; Bakoula *et al.*, 2007). The most consistently cited, strongest and most predictive variables of breastfeeding behaviour, however, point towards maternal socio-economic status, age, smoking status and education attainment level (Scott *et al.*, 2001; Dubois & Girard, 2003a; Gudnadottir *et al.*, 2006). Initiation rates have been indicated as being significantly lower among smokers (Di Napoli *et al.*, 2006) whom if breastfeed, are known to do so for a shorter duration than non-smokers ($p<0.001$) (Bouvier & Rougement, 1998; Giglia *et al.*, 2006). It has been suggested that mothers who smoke are less likely to breastfeed owing largely to lower motivation to breastfeed rather than a physiological effect of smoking on their milk supply (Donath *et al.*, 2004). Conversely, Scott *et al.*, (2004) argued that maternal infant feeding attitude was a better predictor of feeding choice than were demographic factors.

Employment status

Some studies indicate that working, compared to non-working mothers are more likely to initiate breastfeeding (Sayers *et al.*, 1995; Hamlyn *et al.*, 2002; Ward *et al.*, 2004) while other studies have not confirmed this finding (Fitzpatrick *et al.*, 1994; Mid-Western Health Board Study, 1997; Ryan, 1997; Dennis, 2002). A study from the USA (n = 245) indicated that work return (29%) was cited as a principal barrier to breastfeeding among formula feeding mothers (Arora *et al.*, 2000). It has also been shown that mothers in the UK (n = 7,642) who planned to commence work outside the home during the first 6-weeks post partum, compared to those who were not intending to work, were significantly less likely to initiate breastfeeding (Noble *et al.,* 2001).

Parity

Although more multi-parous mothers have been shown to initiate (Ryan *et al.,* 2002), and breastfeed for longer duration than primi-parous mothers (Bulk-Bunschoten *et al.,* 2001), other literature shows the reverse (Noble *et al.,* 2001). It has been suggested that many first-time mothers typically have limited contact with other breastfeeding women and, therefore, have very little experience on which to draw (Sheehan *et al.,* 2001).

1.1.7.2 Maternal exposure to breastfeeding

Positive intention to breastfeed has been associated with mothers' previous breastfeeding experience (Bakoula *et al.,* 2007) and the maternal grandmother having breastfed (Sayers *et al.,* 1995). Fitzpatrick *et al.,* (1994) found that mothers who were breastfed themselves were significantly more likely to breastfeed ($p<0.001$) and most breastfeeding mothers also had sisters or sisters-in-law (65%) and friends (83%) who breastfed their children. This report found that more mothers who breastfed compared to formula fed reported to have witnessed a mother breastfeeding in 'real life' ($p<0.01$). Furthermore, successful breastfeeding initiation has been shown to be dependant on women's self-efficacy levels during pregnancy, as well as a positive intention to breastfeed (Kessler *et al.,* 1995).

1.1.7.3 Ante natal factors

Several Irish (O'Herlihy, 1978; Ward *et al.,* 2004) and international studies (Arora *et al.,* 2000) highlight the positive relationship between mothers ante natal intention to breastfeed and breastfeeding initiation post partum (Ahluwalia *et al.,* 2005). Indeed Donath *et al.,* (2003) found that maternal intention to breastfeed was a stronger predictor of both breastfeeding initiation and duration, than the standard demographic factors combined. In contrast, research from Nepal demonstrated that in 95% of cases, the majority of mothers had decided about the feeding method after the delivery (Chandrashekhar *et al.,* 2007). A body of evidence also indicates that some women make their feeding decision even prior to conception (Fennessy, 1999). It has been shown that the majority of formula-feeding mothers knew that they 'always wanted to bottle feed' (46%) compared to 32% who decided to formula feed during the pregnancy while 39% of breastfeeding mothers reported that they 'always wanted to breastfeed' (Breastfeeding in Northern Ireland, 2003).

Attendance to ante natal classes (Lu *et al.,* 2003) and early commencement of ante natal care (Grjibovski *et al.,* 2005) have been shown to positively influence initiation. However, a previous Irish report indicated that mothers from lower socio-economic groups were less likely to attend ante natal classes, and among the few who did attend the classes, they felt the midwives were too 'pushy' about breastfeeding (Fennessy, 1999).

1.1.7.4 Social factors

Several studies suggest that social factors are key determinants of breastfeeding decisions (Black *et al.,* 1990). Documented predictive factors for initiation include the attitudes of women, their partners (Freed *et al.,* 1993), family members and friends (Paine & Dorea, 2001) as well as health care professionals (Dermer, 1995) towards breastfeeding. In particular, the literature indicates significant and consistent agreement between the father's feeding preference and positive maternal intention to breastfeed (Kessler *et al.,* 1995; Kong & Lee, 2004) as well as being an important positive predictor of initiation (Li *et al.,* 2004). Arora *et al.,* (2000) pointed out that the mother's perception of the father's attitude was the most common reason mothers reported for formula feeding. Moreover, a study from the USA (n = 522) found that the vast majority of breastfeeding mothers (97%) reported that their partners were supportive of their decision to breastfeed (Kuan *et al.,* 1999). A study specifically examining the partners' attitudes showed that those who believed that breastfeeding was 'best for infants', were also more likely to want their partners to breastfeed and had greater respect for breastfeeding women, while partners who encouraged formula feeding were more likely to think that breastfeeding was 'bad for breasts' and 'interfered with sex' (Freed *et al.,* 1992). It has also been shown that a higher proportion of fathers of formula fed, compared to breastfed infants, ante natally reported that they agreed or strongly agreed that the father would feel left out if the mother breastfed (24% versus 11% of fathers respectively) (Scott *et al.,* 2004).

Furthermore, Giugliani *et al.,* (1994) highlighted that paternal attendance to the ante natal classes and breastfeeding knowledge were strongly associated, even after adjustment for socio-economic status. According to work by Li *et al.,* (2004), ante natal class attendance needs to emphasise the ways in which fathers can support and contribute to breastfeeding. It has also been shown that formula-feeding mothers might have chosen to breastfeed had they received more support from the maternal grandmother or other family members (91%), or received more information ante natally (95%) (Arora *et al.,* 2000).

Maternal attitudes and perceptions surrounding breastfeeding

Overwhelming evidence indicates that maternal attitudes and misperceptions, such as mothers reporting that breastfeeding is a 'social taboo' and 'embarrassing', are potential negative barriers to initiation (Loh *et al.,* 1997). Among a sample of inner city mothers from the USA (n = 393) one of the reasons reported for not breastfeeding was the concern about passing 'dangerous things' on to their infants through their breast milk (25%) (England *et al.,* 2003).

Work by Kong & Lee (2004) in Hong Kong (n = 230) indicated that mothers tended to view breastfeeding as socially limiting and felt that mothers should not be tied to their infants. Moreover, a previous Irish study found that mothers who formula fed particularly younger primi-parous women, were more likely to refer to negative stories about people they knew who had breastfed (Fennessy, 1999). Qualitative research from South Australia, which aimed to identify environmental barriers to breastfeeding, reported that formula feeding was perceived to be more convenient for the mother and more acceptable in public, despite the fact that mothers knew breastfeeding was better for the baby (McIntyre *et al.,* 1999).

Conversely, it has been reported that mothers who feel breastfeeding is 'best for the baby' (Ward *et al.,* 2004; Sloan *et al.,* 2006) and those who have high infant feeding attitude scores (Sittlington *et al.,* 2006) were more likely to breastfeed. Parents of breastfed, compared to formula-fed infants have been shown to have more positive attitudes towards breastfeeding and be more knowledgeable about the health benefits and nutritional superiority of breastfeeding (Shaker *et al.,* 2004). Mothers' belief that there is no difference between formula and breastfeeding has also been shown to impact negatively on breastfeeding initiation (Carlson Gielen *et al.,* 1992). It has been suggested that health care professionals are not effective in making known the advantages of breastfeeding to parents (Lowry & Lillis, 1993). In addition, dietary and alcohol restriction have been suggested as barriers to initiation (Fennessy, 1999; Shaker *et al.,* 2004) as well as mothers' uncertainty regarding the quantity and sufficiency of their breast milk (Arora *et al.,* 2000).

1.1.7.5 In-hospital practices

Successful breastfeeding may depend on the support of the health professionals directly involved with breastfeeding mothers (Sharret-Stevens, 2007). Pechlivani *et al.,* (2005) assessed breastfeeding practices in relation to the hospital experience among 1,603 healthy mothers in Athens, reporting that rooming-in, early initiation of breastfeeding, normal vaginal delivery and an infant birth weight > 3000g were positively associated with higher breastfeeding rates. Successful initiation has been attributed to increased midwife support at ward level, with mothers who initiated breastfeeding being more likely to report that the midwife watched them breastfeed and monitored their breastfeeding progress (Kuan *et al.,* 1999). According to Mikiel-Kostyra *et al.,* (2002), breastfeeding within 2 hours after the birth, rooming-in without separation longer than 1 hour per 24-hours, and the implementation of skin-to-skin contact post-birth supported successful breastfeeding, with particular identification of early skin-to-skin contact as being an independent predictor of the duration of exclusive breastfeeding. Furthermore, a Cochrane Database Systematic Review (17 studies, 806 participants) by Anderson *et al.,* (2003) found statistically significant and positive effects of early skin-to-skin contact on breastfeeding at one to three months postbirth (odds ratio (OR) 2.15, 95% confidence interval (CI) 1.10 to 4.22) and on breastfeeding duration (weighted mean difference (WMD) 41.99, 95% CI 13.97 to 70.00).

1.1.7.6 Reasons for not attempting to breastfeed

Lowry & Lillis (1993) indicated that maternal considerations of convenience (37%) and past experience (21%) were among the principal factors influencing mother's feeding choice, compared with the influence of family/friends (7%) and advice from health professionals (5%). Prior Irish-based research (Connolly *et al.,* 1980) showed that the major reason mothers did not want to breastfeed was due to a dislike of the idea of breastfeeding (38%), followed by the perception that formula feeding was more convenient than breastfeeding (24%). The principal reason for not breastfeeding among a sample of mothers in Belfast (n = 274) was due to the practice being 'unappealing' to the mother (37%) and a previous negative experience (16%) (Sloan *et al.,* 2006).

1.1.8 Determinants of breastfeeding duration

Dennis (2002) proposed that the explanation for the premature discontinuation of breastfeeding is complex and multi-faceted. The literature emphasises a higher preponderance and prevalence of breastfeeding among women who are older, educated, married and those with higher family incomes than women who do not breastfeed (Callen & Pinelli, 2004) both in Ireland (Kalapesi & Kevany 1974; O'Herlihy, 1978) and internationally (Scott Taylor *et al.,* 2006). Negative associations have been found consistently with younger mothers, lower social class and educational attainment levels (Foster *et al.,* 1997; Hamlyn *et al.,* 2002) as well as maternal obesity (Donath & Amir, 2000). A trend towards longer breastfeeding duration has also been associated with multi-parous mothers (Simard *et al.,* 2005) however multi-parous mothers, and those without the support of their partner, are more likely to find breastfeeding strenuous (Dulon *et al.,* 2001). Crucially however, the evidence supports a strong socio-economic gradient with breastfeeding duration, with particular reference to the positive influence of higher maternal education levels (Bulk-Bunschoten *et al.,* 2001; Mikiel-Kostyra *et al.,* 2002). In contrast, earlier Irish data demonstrated that longer breastfeeding durations were not associated with mothers' age, social class, marital status, parity, attendance at ante natal classes or intention to return to work (Sayers *et al.,* 1995), however, smokers had a significantly shorter duration of breastfeeding, a finding corroborated by other investigators (Donath *et al.,* 2004). Work by Chaves *et al.,* (2007) in Brazil (n = 246) highlighted that shorter breastfeeding duration was associated ($p<0.05$) with maternal age < 20 years, <5 and >9 ante natal consultations, use of alcohol or tobacco, delay before the first feed (> 6 hours) and use of a pacifier.

A study from Germany (n = 1,593) showed that the risk of short term breastfeeding (< 4 months) was related to lower maternal age and education attainment level, single parent status, delayed skin-to-skin contact (> 1 hour post birth), supplementary feeding during the first 3 days post birth, breastfeeding problems during the first 14 days post birth and the partner's negative attitude towards breastfeeding (Dulon *et al.,* 2001). Other investigators in Canada (Sheehan *et al.*, 2001) and Australia (Scott *et al.,* 2001) have replicated these findings. Work by Piper & Parks (1996) confirmed that mothers in the USA (n = 2,372) were more likely to breastfeed for longer than 6-months if they were non-smokers, attended ante natal classes during pregnancy, had ante natally intended to breastfeed and delayed return to work post partum. Moreover, positive health behaviours have been observed among mothers who breastfeed for longer duration, including non smoking ($p=0.005$) and delayed introduction of solid foods in their infants ($p=0.004$) (Simard *et al.,* 2005).

1.1.8.1 Ante natal factors

The length of time a mother intends to breastfeed (Scott *et al.,* 2001; Bakoula *et al.,* 2007) has also been identified as an important predictor of duration. Mothers in the UK (n = 11,111) who intended to breastfed for less than one month, compared with those who were planning to breastfeed for at least four months, were 78% more likely to stop at any given time (Donath *et al.,* 2004). Consistent with these findings, Blyth *et al.,* (2004) found that mothers who intended to breastfed for < 6 months were 2.4 times as likely to have discontinued breastfeeding at 4 months compared with those who intended to breastfeed for > 12 months. Furthermore, Scott *et al.,* (2001) demonstrated that duration of breastfeeding was most strongly associated with the length of time a mother intended to breastfeed (OR 4.18, 95% CI 2.81-6.22). A prospective study by McLeod *et al.,* (2002) indicated that mothers were less likely to breastfeed between 6-10 weeks post partum if they believed that they needed more breastfeeding information prior to the delivery or if they experienced breastfeeding problems.

1.1.8.2 Employment status

Early return to work, introduction of a pacifier and breastfeeding difficulties in the first 4-weeks (Scott *et al.,* 2006) as well as having the infant cared for in a child-care facility (Scott *et al.,* 2001) have been identified as further negative determinants of breastfeeding duration. Other investigators have demonstrated shorter breastfeeding duration rates among working mothers (Bouvier & Rougement, 1998; Bulk-Bunschoten *et al.,* 2001) which becomes particularly apparent at 4-months post partum ($p<0.05$) (Earland *et al.,* 1997). Paine & Dorea (2001) found that stay-at-home mothers intended to breastfeed significantly longer than those who were employed. More recently, Sloan *et al.,* (2006) found that work return was the most commonly cited reason for breastfeeding cessation in 21% of cases, followed by mothers' concern that the baby was not 'getting enough breast milk' (16%).

1.1.8.3 Reported barriers to the continuation of breastfeeding

Irish data indicate that the most common reasons given for discontinuing breastfeeding following discharge from the maternity hospital relate to maternal physical problems associated with breastfeeding practice, including sore nipples, engorgement and breast pump difficulties, as well as maternal tiredness/exhaustion (Fennessy, 1999). Breastfeeding cessation during the first two weeks post partum has been associated with factors such as having a sleepy infant (17%), tender nipples (8%) and infant illness (8%) whereas discontinuation of breastfeeding by six and twelve weeks has been related to mothers' perception that the baby was getting insufficient milk in 60% and 43% of cases respectively (Lowry & Lillis, 1993). The mother's perception that her milk supply was insufficient to meet her infant's needs (Howell *et al.,* 1996; Berovic, 2003) and the perception that her infant was hungry (Hurley & Fogarty, 1992) and preferred formula milk (Ertem *et al.*, 2001) have been reported by other investigators as the chief reasons for discontinuation during the early months post partum. Moreover, maternal infant feeding attitudes have been independently associated with duration rates (Scott *et al.,* 2006).

Beyond the first few months, maternal-related issues have been reported as reasons for discontinuation such as maternal tiredness (Howell *et al.,* 1996), a personal preference to voluntarily discontinue the practice (27%) and work return (16%), while maternal physical problems such as mastitis (9%) and infant/maternal illness (5%) feature as less prominent reasons (Hurley & Forgarty, 1992).

A prospective cohort in the Netherlands (n = 4,438) reported other maternal-related motives for discontinuing breastfeeding including mothers' sense of being restricted by breastfeeding (20%) and fatigue (20%) while mothers' perception of infant hunger (24%) and crying (19%) were the main infant-related reasons for cessation of breastfeeding (Bulk-Bunschoten *et al.,* 2001).

1.1.8.4 Support network

Perceived social support for breastfeeding from the infant's father and the maternal grandmother has been shown to positively influence breastfeeding duration (Scott *et al.,* 2001). Partners' support of breastfeeding during pregnancy has also predicted longer breastfeeding duration, while higher relationship distress levels were predictive of early breastfeeding cessation (Sullivan *et al.,* 2004). Maternal inability to get help with breastfeeding has been independently highlighted as a risk factor for early discontinuation of the practice (Sheehan *et al.,* 2001).

1.1.8.5 Personal factors, including exposure to breastfeeding

The strong influence of mothers' previous breastfeeding experiences (De Lathouwer *et al.*, 2004) and prior exposure to friends and family members' breastfeeding is consistent in the literature (Chandrashekhar *et al.*, 2007). A study by Meyerink & Marquis (2002) in the USA showed that mothers who breastfed at 1 month were more likely to have close relative who breastfed (OR 1.89) while breastfeeding > 1 month was associated with mothers who were breastfed themselves as infants (OR 6.88) and having breastfed a previous infant (OR 10.89). Maternal breastfeeding self-efficacy has also been suggested as a significant predictor of breastfeeding duration with higher levels being associated with increased likelihood of exclusive breastfeeding at 1 week and 4 months post partum (Blyth *et al.*, 2002). Mothers who lacked confidence in being able to breastfeed up to two months post partum were more likely to discontinue breastfeeding within the first 2 weeks post partum (Ozturk Ertem *et al.*, 2001). Moreover, Chezem *et al.*, (2003) correlated mothers' breastfeeding confidence with breastfeeding knowledge and actual lactation duration. Convincing evidence suggests that mothers with the highest, compared to the lowest level of breastfeeding knowledge are more likely to be exclusively breastfeeding at 3 (OR 6.5) and 6 (OR 1.97) months post partum (Susin *et al.*, 1999).

1.1.8.6 Other factors

An increased risk of not being breastfed at 3 months of age has been related to supplementary feeding at birth and birth weight < 3 kg among a cohort of Italian infants (n = 1,567) (Faldella *et al.*, 1999). Mothers who introduce supplementary formula milk during the first month are almost 3 times (OR 2.79) more likely to breastfeed for a shorter duration (Vogel *et al.*, 1999), however, Gray-Donald *et al.*, (1985) proposed that formula supplementation in the hospital is a marker, rather than a cause of breastfeeding difficulty.

1.1.9 Conclusions

Compelling research supports breastfeeding as the optimal infant feeding method from birth, and almost all mothers, if adequately informed and supported, could provide sufficient breast milk for their infants (Campbell, 1996). Despite this convincing evidence, a large proportion of mothers in Ireland do not attempt the practice. The most recent figures reported in the National Perinatal Statistics (2004) highlight that the majority of infants born in Ireland never experience the benefits of breast milk, a pattern which has been observed over the last forty years. The fact that a plethora of well designed international studies in both developed and developing countries report high breastfeeding initiation and duration rates across all socio-economic groups indicates that it is possible for the majority of mothers to breastfeed. Nonetheless, an environment that supports mothers to breastfeed in Ireland is still not being achieved.

Ascertaining the factors important to a mother’s decision about how to feed her infant is reported as being a crucial component to improving rates (Losch *et al.*, 1995), however, Irish investigators highlight a number of knowledge gaps concerning breastfeeding in Ireland (Fennessy, 1999; FSAI, 1999).

Firstly, limited national research has comprehensively documented accurate breastfeeding duration rates using standardized feeding status definitions. There is a clear need for the conduct of robust, prospective, regional and national feeding studies representing all socio-economic groups, with an emphasis on ensuring the standardized ages of infants at follow-up, and use of well-defined breastfeeding definitions. Moreover, standardising ‘breastfeeding operationalised indicators’ in infant feeding studies is vital for the optimization of methodological rigour and the determination of true breastfeeding initiation and duration rates (Yngve & Sjostrom, 2001a).

Secondly, following a thorough review of national research, it also appears that no data exist on the breastfeeding rates of non-national mothers. Since the non-national population accounts for 10% of the current population in Ireland (Central Statistics Office [CSO], 2006) it seems important to investigate their breastfeeding practices. Furthermore, few studies have incorporated multivariate statistical techniques such as regression analyses with adjustment for potential confounding variables, which are reported to be critical to the methodological criteria and rigour (Bauchner *et al.*, 1986). In a review of breastfeeding practices across Europe, Yngve & Sjostrom (2001a) reported that inefficient and unreliable monitoring systems still exist, and highlighted a lack of reported exclusive breastfeeding rates and total duration of exclusive breastfeeding, as well as the effects of various demographic, socio-economic, social and medical determinants on breastfeeding patterns.

It is well acknowledged internationally that Irish breastfeeding rates are among the lowest in the world. Furthermore, very few comprehensive studies have examined the reasons for these continued low rates. Considering the shift towards economic prosperity over the latter ten years in Ireland, accompanied by larger proportions of working mothers in the workforce as well as the recent increased immigrant population, it has never appeared more critical to investigate the impact of such economic and social influences on mothers' feeding decisions.

Gillman (2002) suggested that future observational studies would be stronger if they directly measured why women choose a certain method of feeding. Moreover, emerging evidence indicates that increased initiation and duration of breastfeeding may also provide a low cost, readily available strategy to help prevent childhood and adolescent obesity, which may be of public health significance considering the current epidemic of childhood overweight (Dewey, 1993).

1.2 Weaning practices

1.2.1 Introduction

A nutritionally adequate diet during infancy is essential for growth and development, and is well known to have an impact on health and nutrition, possibly of greater significance than at any other age (Fall *et al.,* 1992; Owen *et al.,* 2002). During the first year of life, an infant's birth weight is doubled by 6 months and tripled by 1 year, with an increase in length of 50% (Thomas & Bishop, 2007), a process that is not repeated at any other phase during the life cycle. This rapid growth rate necessitates adequate nutrition and the correct balance of nutrients to match this increasing growth velocity. Relative to their size, infants have a high requirement for energy and nutrients. For instance, at 6-months of age, the daily estimated average energy requirement of a 6-month old (95kcals/kg/body weight[*]) can be almost 3-fold the daily energy requirement of an adult male (19-49 years: 34kcals/kg/body weight[∞]) per kilogram of bodyweight, while an infant's estimated daily iron requirement (4.5mg/day[*]) is 45% that of the iron requirement of an adult male (18-64 years: 10mg/day[†]). Furthermore, in the term infant (born ≥ 37 weeks gestational age), the total haemoglobin mass doubles during the first year of life from 180mg at birth to 340mg at 1 year (Wharton, 1999). To achieve these requirements, careful consideration of the weaning diet becomes essential. Above all, an infant's gastric capacity for food is more limited than that of adults, so the foods they are offered should be nutrient dense and provided in a compact form (Allen & Myers, 2006).

The weaning period is a sensitive transition, yet provides a critical window of opportunity for the introduction of new foods and textures. The process plays a key role

[*] Great Ormond Street Nutritional Requirements, 2002
[∞] Dietary Reference Values for Food Energy and Nutrients for the UK, HMSO, 1991
[†] Food Safety Authority of Ireland, Recommended Dietary Allowances, 1999

in ensuring nutritional adequacy against a backdrop of increased energy, protein and micronutrient requirements. Moreover, early childhood is a time when life-long eating patterns are established (Cooke, 2007). The literature confirms that inappropriate weaning practices, such as the early introduction to solids, may have marked implications for infant health, notably in relation to normal development and mineral balance (Department of Health UK, 1994). Evidence is also accumulating that early infancy may be a critical period for the development of obesity (Southern Area Health Service Executive, 2005). Previous research has associated rapid weight gain during the first 6-months of life with overweight during childhood (Stettler *et al.,* 2002; Dennison *et al.,* 2006) and greater general and central adiposity at five years (Ong *et al.,* 2000). With markedly increasing obesity levels during childhood (Snethen *et al.,* 2007) and adulthood worldwide (WHO, 2003b), there is thus a greater emphasis on ensuring proportionate growth and encouraging sound eating habits from infancy. Moreover, it is established that adult eating habits are learned during infancy and the toddler years (Alan & Myers, 2006).

Definitions

Weaning is a process involving the introduction of solid foods into an infant's diet resulting in the gradual replacement of breast or formula milk as the main source of nutrition. The Committee on Medical Aspects of Food and Nutrition Policy (COMA, 1994) defines weaning as 'the process of expanding the diet to include foods and drinks other than breast milk or infant formula'. 'Complementary feeding' is a term devised by the WHO pertaining only to breastfed infants, which describes the provision of any nutrient-containing food or liquids other than breast milk, including solid and semi-solid foods along with infant formula milk (WHO Indicators for Assessing Breastfeeding Practices, 1991). The WHO uses the term 'weaning' in an intentionally limited sense to indicate complete cessation of breastfeeding (Lanigan *et al.,* 2001).

The terms 'weaning', 'transitional feeding' and 'complementary feeding' are sometimes used synonymously in the literature to mean infant solid feeding. For the purpose of this thesis however, the term 'weaning' is used to denote the introduction to solids while the complete cessation of breastfeeding will be specifically qualified and differentiated as 'weaning off the breast'.

1.2.2 The weaning process

Three key stages differentiate the weaning process (see **Appendix V**). Each weaning phase is age-specific and aims to achieve several nutritional and developmental milestones. The overall aim of the weaning process is to gradually accustom the infant to a range of foods, flavours and consistencies, commencing with thin purees, to a diet based around family foods and meals. A number of essential feeding skills (Pridham, 1990), attitudes and habits concerning food and health are acquired during this period of primary socialization (Rugg-Gunn & Nunn, 1999).

Whether mothers choose to wean their infants within a range of 4 months/17 weeks to 6 months, or at 6 months, it is recommended that they comply with feeding guidelines in accordance with the 'first weaning stage'. The literature emphasises that infants who are weaned at 6 months/26 weeks, in line with the WHO (2001) recommendations, should be quickly moved on to the 'second weaning stage', hence preventing any feeding problems at later stages. A delay in weaning infants at the recommended time, or lack of progression through the weaning stages within the recommended age ranges, may deleteriously affect feeding behaviour (Northstone *et al.,* 2001) and oro-motor and speech development (Harris, 2004). In addition, delayed introduction to solids among exclusively breastfed infants beyond 6 months may increase their risk of iron deficiency anaemia (IDA) (Wharton, 1999). According to Skuse (1993), limited food variety in the weaning diet during the first year can lead to food refusal and reluctance to try new foods during toddlerhood. There is also evidence to show that early feeding difficulties established during infancy, persist until age 2 years of age (Dahl, 1987). Earlier landmark research by Illingworth & Lister (1964) described a critical or sensitive period between 6 and 7 months, suggesting that ‘if infants are not given solid foods to chew at a time when they are first able to chew, troublesome feeding may occur’. Moreover, some evidence exists to suggest that delayed weaning may result in under-nutrition and poor weight gain (Whitehead *et al.*, 1986), failure to thrive (Wright & Birks, 2000) and increased malnutrition and micronutrient deficiency risk owing to an inadequate dietary intake (Hendricks & Badruddin, 1992).

1.2.2.1 The first weaning stage (4 months/17 weeks - 6 months)

The initial weaning stage aims to accustom the baby to taking food from a spoon, which is a key learning skill. Davies & O’Hare (2004) emphasised that food intake during the early weaning stage serve largely as a ‘taster’ given by spoon, one to two times per day. Initially, foods should be offered before milk feeds, first on one, then on two occasions per day (Child Nutrition Panel, 2003). Savoury and bland tastes should be encouraged and mothers are advised to avoid sugar and salt additions to foods or drinks. The inclusion of sugar-containing foods should be avoided including cakes, biscuits, sweets as well as highly salted foods including gravy, processed sauces, tinned/processed soups, cured meats and crisps. Recommendations discourage the provision of snacks high in salt, fat and sugar during the weaning process.

Recommended first foods

First foods should be gluten free, pureed/semi-solid and mixed with baby’s usual milk (breast or formula milk). The Department of Health (UK, 1994) suggest that a range of ideal first foods could be offered to infants including 1-2 teaspoons of gluten free cereal (baby rice), mashed potato, natural yoghurt, pureed fruit or vegetable, while gradually increasing the variety to include pulses and pureed meat.

Dairy foods can also be offered as first weaning foods such as unsweetened fromage frais, cottage cheese, plain yoghurt and custard (Kalnins, 2007a).

To identify a food intolerance or allergy associated with a particular food or food group, the AAP (1998) recommends that mothers introduce single-ingredient weaning foods, one at a time, for a few days, before introducing a new food. The usually accepted list of allergenic and enteropathic foods include gluten-containing cereals (wheat, barley, rye and oats), cow's milk, egg, fish, soybean and nuts, all of which should be avoided during the first six months (COMA, 1994; Koletzko, 2000).

International and national weaning guidelines strongly emphasise the importance of avoiding any additions of solid foods, such as cereals and rusks, to bottled infant formula or breast milk feeds (COMA, 1994; Child Nutrition Panel, 2003). The commonly held belief by parents that the addition of solid foods to such feeds, may promote infant sleep is neither recommended nor effective for most infants, and may delay the weaning process and the infant's developmental progression (Shaw & Lawson, 1994). Furthermore, this practice may result in the premature introduction of solids before the infant has developed the skills to eat from a spoon (Brown, 2005) and may increase the risk of choking, dental caries development and hypernatraemia.

1.2.2.2 The second weaning stage (6-9 months)

Beyond the initial weaning stage, it is critical that solid foods play a significant role in providing energy and nutrients, with breast or formula milk becoming less important as a sole source of nutrition. Infants who are weaned at or near 6-months, after a shortened period on pureed consistencies, will need to progress to the second weaning stage quicker than those weaned earlier, to ensure nutritional adequacy and the continued development of normal feeding behaviour (Northstone *et al.,* 2001).

The Child Nutrition Panel (2003) suggested that between 7 and 8 months the energy intake from milk (breast or formula) and solid foods should be equally distributed (50% and 50% respectively). Current evidence from the US confirms that the most precipitous drop in the contribution of breast and formula milk to an infant's energy intake occurs between 4 to 5 months (from 88% of total energy to 66%) and from 6 to 8 months, as the solid intake increases (Kay-Fox *et al.,* 2006).

Recommended foods from 6-9 months

The intermediate weaning stage should provide a diet with a greater variety of tastes and textures while also encouraging the infant to experiment with finger foods. Coarsely pureed meat, soft cooked fish or pulses, cereals, well-cooked egg, fromage frais, finger foods such as soft fruit and vegetables are recommended food types during this period. Typically during this stage, infants consume 2-3 spoon feeds daily resulting in a reduction of milk feeds to 500-600mls daily (COMA, 1994). The infant should be offered at least 1 serving of a protein source (meat, fish or other protein source), 2-3 servings of bread/potatoes and cereals and 2 servings of fruit and vegetables daily. Foods offered at, or around six months should be nutrient dense and high in iron including meat, oily fish and pulses (BDA Paediatric Group Position Statement, 2004). The inclusion of iron rich weaning foods, such as meat, is particularly important in the diet of breast fed infants from 6-months and beyond owing to their decreasing neonatal iron stores between 4-6 months (Wharf *et al.,* 1997).

Low fat or high fibre foods are inappropriate weaning choices owing to the low nutrient and energy densities of the former, and high satiating value of the latter. To promote sound healthy eating habits from infancy, it is not desirable to offer infants excessive amounts of fatty foods or highly refined added sugars (Thomas & Bishop, 2007). In addition, a beaker cup should be introduced at 6-months and beyond, in which any supplementary fluids such as cooled boiled water should be offered.

1.2.2.3 The third weaning stage (9-12 months)

The final weaning stage should reflect a more mature diet consisting of 3 modified family meals daily, interspersed with 2-3 between meal healthy snacks (COMA, 1994). Foods should be of varying texture, taste and quantity (Sarwar, 2002). From 1 year of age, a child should be capable of participating in family meals and eating at least some family foods (Foote & Marriot, 2003). During the third weaning phase, infants should be offered 1-2 servings of a protein source daily (meat, fish and other protein source), 3 servings of bread/potatoes and cereals and 3-4 servings of fruit and vegetables. Breast or formula milk should provide 40-45% of the infants total energy intake and solids approximately 55-60% of the total energy intake.

There should be no reluctance in giving an infant chopped, minced or lumpy food textures nearing 12 months. COMA (1994) advised that the change from breast or infant formula to cow's milk should ideally be delayed until after 12 months while discouraging drinks other than breast milk, formula and water during the first year. The more diverse the infant's diet nearing 12 months, the increased likelihood of better food acceptance during later infancy and toddlerhood (Thomas & Bishop, 2007). It has been stated that the weaning process is not complete until the energy intake from breast or formula milk is replaced by foods and beverages (Brown, 2005). Moreover, as the gastric capacity increases, most infants progress from feeding approximately 180mls/kg per day in two to three hour intervals to less frequent, higher volume and density feedings by the end of the first year (Hendricks & Badruddin, 1992).

1.2.3 Functions of the 'weaning process'

The overall aim of the weaning process is to encourage the successful transition from pureed semi-solid foods to a diet based around family foods and meals by the end of the first year. The central functions of the weaning process are underpinned by a number of nutritional and developmental-related transitions and achievements.

1.2.3.1 Nutritional functions

Nutritionally, the weaning process is associated with major changes in micro and macronutrient intakes. To meet the infant's changing and increased demands for these nutrients which are imposed by rapid growth, the introduction of solid food becomes essential. Moreover, from 6-months, breast or formula milk are no longer adequate to meet the infant's increased nutritional requirements with particular reference to protein, energy, iron, zinc, protein, vitamins A and D (Calvo *et al.,* 1992; Mughal *et al.,* 1999). Postnatal nutrient stores of iron for instance, deplete between 4-6 months, increasing the reliance on dietary sources to meet requirements (Oski, 1993). Additional functions of the weaning process require that the infant is introduced to an increased variety of tastes, textures, flavours and dietary consistencies (FSAI, 1999).

1.2.3.2 Developmental functions

The timely introduction of solid food serves to encourage the development of gross and fine motor control, exploratory behaviour and manual dexterity (Hendricks & Badruddin, 1992) as feeding skills progress from immature sucking and swallowing, to biting and chewing (Thomas & Bishop, 2007). The initial process of offering food on a spoon to infants around the 6-month time point aims to stimulate mouth muscle development (Brown, 2005). Neuromuscular co-ordination and oro-motor skills are also established, including speech development (Stevenson & Allaire, 1991; Skuse & Wolke, 1992). **Table 1.4** outlines the infant developmental feeding skills achieved in accordance with the weaning stages.

Table 1.4. Infant development during the first 12 months

Age (months)	Developmental feeding skill
4-6	✓ Extrusion reflex diminishes ✓ Ability to swallow non-liquid foods develops ✓ Hand to mouth co-ordination ✓ Chewing action begins **Infant:** ✓ Grasps objects with palm of hand ✓ Sits erect with support at 6-months ✓ Indicates disinterest or satiety in food by leaning back or turning away
6-8	**Ability to:** ✓ Self feed finger foods ✓ Drink from a beaker cup ✓ Develop finger to thumb grasp
8-10	**Ability to:** ✓ Hold own bottle ✓ Sit unsupported ✓ Reach for and grab spoon and food
10-12	✓ Begins to master spoon

Adapted from Rolfes, Pinna and Whitney (2006a) ‘Understanding Normal Clinical Nutrition’

1.2.4 International weaning recommendations

In 2001, the WHO issued a global recommendation that mothers should exclusively breastfeed for the first six months of life thus delaying the introduction of solids until this point. This recommendation is based on the outcome of a review of scientific knowledge on complementary feeding in developing countries (WHO, 1998) and is supported by an extensive systematic review commissioned by the WHO and conducted by Kramer & Kakuma (2002).

1.2.4.1 The Kramer & Kakuma (2002) review

The main objective of the Kramer & Kakuma (2002) review was to assess the effects of exclusive breastfeeding during the first 6 months of life, compared with exclusive breastfeeding for the first 3-4 months with the inclusion of solid foods from this point and beyond, on parameters such as child and maternal health, growth and development. The consolidated evidence underpinning these observations supported the safety of exclusive breastfeeding during the first 6-months of life. Moreover, the reviewers found that there were added advantages to delaying the introduction of solids during this period, particularly in developing countries.

Health and Growth

Kramer & Kakuma (2002) surmised that neither controlled clinical trials nor observational studies from either developing or developed countries suggested growth deficits among infants who were exclusively breastfed during the first 6 months of life, versus those who were weaned onto solids at 3 or 4 months. Previous investigators agreed that with regard to infant growth, there is no benefit to introducing foods other than breast milk prior to 6-months (Cohen *et al.,* 1994; Frongillo & Habicht, 1997). Other research in India however, has not confirmed these findings, highlighting that stunted growth was least common among infants weaned onto solids prior to 3 months and that nearly two thirds of infants weaned at 6 months were classified as being in the 'stunted growth' category (Padmadas *et al*., 2002).

Two randomised intervention studies conducted in Honduras lend support to the safety of prolonged breastfeeding and delayed introduction of solids until 6 months (Cohen *et al.,* 1994; Dewey *et al.,* 1999). These interventions indicated that there was no significant disadvantage for morbidity or growth when complementary foods were introduced at 4 months, versus continued exclusive breastfeeding to 6 months. Exclusive breastfeeding during the first 6-months has been demonstrated to confer particular benefit to infants in developing countries by reducing the risks of gastro intestinal infection (Kramer *et al.,* 2000), diarrhoeal and respiratory illness compared to infants weaned onto solids prior to 6 months (Brown *et al.,* 1989; Popkin *et al.*, 1990).

Maternal health advantages

Data from a Honduran study (Dewey *et al.,* 1997) suggested that in settings with a high breastfeeding frequency, prolonged and exclusive breastfeeding until 6-months was associated with the delayed resumption of the menstrual cycle, however, the effects were not seen in mothers who maintained a low breastfeeding frequency. Moreover, Kramer & Kakuma (2002) confirmed the health benefits for breastfeeding mothers highlighting that prolonged exclusive breastfeeding results in more rapid weight loss post partum. Overall, such maternal advantages present an additional benefit of exclusive breastfeeding during the first 6 months, particularly in developing countries.

The optimal age for weaning

As a general policy, exclusive breastfeeding for the first 6-months of life remains the global recommendation for all infants in both developing and developed countries. Despite the conflicting and differing opinions within the scientific community with regard to the WHO (2001) recommendation, it could be viewed that the guideline is a necessary population strategy for developing countries where the use of potentially contaminated and/or low nutrient density foods increases the infant's risk of diarrhoeal illness and under-nutrition (AAP, 2004) and for certain infants in the developed world. On a global basis, the WHO (2001) acknowledged that infants must be managed individually, so that insufficient growth or other adverse outcomes are not ignored and appropriate interventions are provided. Countries were urged to adopt and implement these recommendations taking account of national circumstances and respecting local traditions and values as part of their overall nutrition and child-health policies and programmes. This opinion has been adopted by the Department of Health UK (2003) and further substantiated by authors, purporting that individual circumstances need to be considered when professionals are giving advice on weaning to both breast and formula feeding mothers (Lanigan *et al.,* 2001; Foote & Marriot, 2003).

Investigators in the paediatric nutrition domain argue that there may not be a single optimal age for the introduction of solids for all breastfed infants (Garza & Frongillo, 1998). Moreover, data are lacking to form evidence-based recommendations for the introduction of solids in formula fed infants (Fewtrell *et al.,* 2007). It has been suggested that advice and recommendations for weaning only provide guidelines, thus carers must make individual decisions according to their own infants' needs (Northstone *et al.,* 2001; Farrell, 2005). Ford *et al.*, (1995) called for the adoption of a more casual and less clinical approach to current weaning guidelines, suggesting that to best serve the baby's needs, the introduction of solid foods should be 'baby led' and started when the baby is physiologically and developmentally ready. Developmental indications may include the infant's ability to sit up and support their head or an interest in other people eating (Shaw & Lawson, 2007).

It has been hypothesised that the energy intake from breast milk may be inadequate to meet an infant's energy requirements by 6-months post partum and that weaning onto solids prior to 6 months is a degree of responsiveness to infant and maternal needs (Reilly & Wells, 2005). There is also some evidence to indicate that breastfed infants may be at greater risk of IDA if they are exclusively breastfed beyond 6-months in developing (Pizarro *et al.,* 1991; Calvo *et al.,* 1992; Torres *et al.,* 2006) and developed settings (Hopkins *et al.,* 2007). However, the introduction of solid foods has been implicated as cause of a marked decrease in iron bioavailability from human milk (Oski & Landaw, 1980). Overall, multiple factors need to be considered when advising mothers on an optimal weaning time including birth weight, pre partum maternal nutritional status and environmental conditions. Despite the differences in opinion as regards the WHO (2001) guidelines, all expert groups agree that there is no nutritional indication to include solid foods in the diet of healthy term infants prior to 4 months (FSAI, 1999; AAP, 2004; ESPGHAN, 2008).

In reality, a disappointing proportion of mothers are exclusively breastfeeding by six months, if at all (WHO Global Data Bank on Breastfeeding, 1991), while the evidence demonstrates that the vast majority of infants nationally (McSweeney & Kevany, 1982; Freeman, 1996; Twomey *et al.,* 2000) and internationally (Ford *et al.,* 1995; Giovannini *et al.,* 2004; Donath & Amir 2005) are weaned onto solids by six months.

1.2.4.2 UK weaning recommendations

In line with the WHO (2001) revised infant feeding recommendation, the Department of Health UK (2003) issued a statement that *'exclusive breastfeeding is recommended for the first 6 months/26 weeks of an infants life, as it provides all the nutrients a baby needs'*. A wide range of voluntary and professional bodies supported this recommendation including the Royal College of Midwives, the Community

Practitioners and Health Visitors' Association, voluntary and non-government organisations.

In 2001, the UK's Scientific Advisory Committee on Nutrition (SACN) stated that there is sufficient evidence to indicate that exclusive breastfeeding for 6-months is nutritionally adequate to support normal infant growth. More recently, SACN (2003) discussed the benefit of delaying the introduction of solid foods for both breast-fed and formula fed infants. The Committee agreed that *'the appropriate age for introducing solid foods in bottle fed infants depends on the developmental readiness of the infant, but this has not been adequately defined; any risks associated with delaying complementary feeding to 6 months were likely to be low and recommended these be assessed through risk management'*.

Furthermore, COMA has set standards for feeding during the early years of life. Guidance on weaning is based on the COMA report 'Weaning and the Weaning Diet', Department of Health (1994), on which many of the weaning guidelines in this thesis are based and to which current weaning practices are compared.

1.2.4.3 Irish weaning recommendations

In 1999, the Food Safety Authority of Ireland (FSAI) devised a comprehensive national infant feeding policy incorporating evidence-based weaning recommendations. This policy document* acknowledges that there may be wide physiological variation in the needs of individual infants, however as a general recommendation, solid foods should be introduced between the ages 4 and 6 months for both formula and breast fed infants. FSAI (1999) supported exclusive breastfeeding for the first 4-6 months of life, however, stated that several factors should be considered when giving advice to mothers including large birth weight and infant illness (Krebs & Hambridge, 2007), poor maternal nutrition during pregnancy (Raiten *et al.,* 2007) and

* Recommendations for a National Feeding Policy for Ireland, Food Safety Authority of Ireland (1999)

post natally (Renault *et al.,* 1999), rapid growth of the infant creating an increased demand for energy and nutrients as well as extent of post natal utilisation of the infant's nutrient stores (Colomer *et al.,* 1990; Oski, 1993; Pisacane *et al.,* 1995; Lanigan *et al.,* 2001; Godfrey & Barker, 2003).

In August 2003, the Department of Health and Children revised the national feeding recommendations, agreeing that the WHO (2001) guideline is optimal for most babies but that it is not appropriate for all. More specifically, *'health professionals involved in advising breastfeeding mothers should promote exclusive breastfeeding up to 6 months where this is optimal'.* As regards the infant who is not breast-fed, *'suitable infant formula milk should be offered as their main drink during the first year of life, in addition to complementary solid foods after 4-6 months of age'.* Thus, while breastfeeding mothers in Ireland are encouraged to delay the introduction of any food or drink, other than breast milk until their babies are 6-months old, guidelines for formula fed infants are more flexible stipulating that solids can be introduced between 4-6 months.

1.2.4.4 Recommendations on the use of supplementary fluids

Fluids other than formula or breast milk are known as 'supplementary fluids' including cooled boiled water, ordinary juices or commercially prepared baby juices. Infant feeding recommendations stipulate that cooled, boiled water should be the first choice supplementary drink for infants and that from the age of 6-months diluted fruit juices or baby drinks can be given as part of a meal (Department of Health UK, 1994).

The AAP (2001) recommend that juice should not be introduced into the diet of infants before 6 months, as there is no nutritional indication to feed juice to infants prior to this stage. In cases where mothers choose to offer juices, 100% juices should be used, and juice consumption should be limited to 120-180mls daily. Irish infant feeding guidelines (FSAI, 1999) advise that milk and cooled boiled water should be the only drinks given up to the age of about 4 months. Guidelines discourage the use of fruit drinks in lieu of milk, together with carbonated drinks, owing to their unpredictable composition and high acidity. Colas and other caffeine-containing drinks should also be avoided. Drinks containing artificial sweeteners such as 'diet drinks' are not recommended for use in infants and may be just as acidic and detrimental to teeth as sugar containing alternatives (Thomas & Bishop, 2007).

Concern has been highlighted over the increasing trend as regards the provision of fruit drinks to infants, often in place of breast or formula milk, which could lead to a deficiency in minerals including calcium, iron and zinc (Gibson *et al.,* 1997) and dental caries development (Konig & Navia, 1995). The consumption of excessive quantities of sweetened drinks may interfere with an infant's appetite and may lead to a habit of high dietary intakes of non-milk intrinsic sugars (De la Hunty *et al.,* 2000). Excess fruit juice intake (> 250mls/day) can also lead to diarrhoea owing to the high fructose and sorbitol content of fruit juices (AAP, 1991). Furthermore, children may be conditioned to sweet tasting drinks at an early age (Emmett *et al.,* 2000).

It has been suggested that the consumption of sugar sweetened drinks including carbonated and fruit drinks may be a key contributor to the epidemic of overweight and obesity during childhood and adulthood owing to the high added sugar content, low satiety value and incomplete compensation for total energy (Malik *et al.,* 2006). In a report from the USA, Dennison *et al.*, (1997) found that the consumption of more than 336mls of fruit juice daily was associated with shortness of stature and obesity in a group of otherwise healthy 2 and 5 year olds. Other investigators, however, have been unable to confirm this association (Alexy *et al.,* 1999; Skinner & Carruth, 2001). Excessive fruit juice consumption (360mls-900mls per day) has also been reported as a contributing factor in non-organic failure to thrive in 14-27 month olds (Smith & Lifshitz, 1994).

Non sugar-containing supplementary fluids

Mineral waters are deemed unsuitable fluids for infants due to the high solute and inadequate fluoride content. Tea, both ordinary and herbal, has a high tannin content, which can bind iron and other minerals and may decrease their bioavailability (Department of Health UK, 1994) leading to the inhibition of iron absorption (Fairweather-Tait, 1992). An examination of drink consumption among a group of 122 infants aged 6-12 months concluded that tea drinkers had a higher prevalence of microcytic anaemia than non-tea drinkers (Merhav *et al.*, 1985).

International research indicates that the provision of supplementary fluids to infants is a common practice. According to Briefel *et al.*, (2004a), 22% of infants in the US aged 4-6 months consumed a mean volume of 120mls of 100% juice daily. Similar findings by Petter *et al.*, (1995) identified squash drinks as the most popular drink of infants and pre-school children. A randomly chosen sample of 1,000 infants in a UK study found that a quarter of infants were consuming fruit drinks at 4-months and over half (55.8%) were consuming a squash/cordial fruit drink by 8 months (Emmet *et al.,* 1999). Freeman (1996) reported that Irish infants were offered juice and tea from a bottle, 43% and 12% respectively, at 18 months; however data were not collected on the fluids consumed at 6 months.

Appendix VI summarizes the weaning recommendations for exclusively and partially breastfed and formula fed infants based on the WHO (2001) recommendations, along with the FSAI (1999) guidelines and the revised Department of Health UK (2003), and the Department of Health and Children (2003) feeding guidelines from birth to 12 months.

1.2.5 Weaning patterns

Infancy is a crucial period for the formation of eating habits that may affect later nutrition, health and feeding patterns (Devaney *et al.,* 2004). Patterns of behaviour learned during this time are very resistant to change subsequently (Rugg-Gunn & Nunn, 1999). Previous studies indicate that food preferences develop early in life (Birch, 1998; Glinsmann, 1999) being particularly influenced by family eating habits (Picciano *et al.,* 1999). According to Harris (1993) 'infants know what they like, and like what they know'. Longitudinal studies suggest that eating patterns of children strongly track over periods of 19 months to more than 6 years for macronutrients (Stein *et al.,* 1991; Wang *et al.,* 2002), fruit and vegetable consumption (Resnicow *et al.*, 1998), meats (Wang *et al.,* 2002) and overall food preferences (Skinner *et al.,* 2002a). Food-related experiences at 2 years and earlier, have been shown to predict fruit and vegetable variety in the diets of 8 year olds (Skinner *et al.,* 2002b). Considering the evidence that food-related behaviours and patterns may have their origins before the age of 2 years (Skinner *et al.,* 2004), it is of key public health importance to report meal and snack patterns from infancy onwards.

1.2.6 Inappropriate weaning practices and health implications

Inappropriate weaning practices are those that do not comply with current recommendations as outlined in **Table 1.5**.

Table 1.5. Summary of inappropriate weaning practices

Early introduction to solid foods (≤ 12 weeks)
Late weaning on to solid foods (> 6 months)
Prolonged and exclusive breastfeeding beyond 6 months
Over-zealous healthy eating guidelines to infants e.g. a diet high in dietary fibre and low in fat
Parental diagnosis of food allergy/intolerance with consequent food restrictions
Use of nutritionally incomplete breast milk substitutes such as goat's milk and soya milk
Restrictive diets (e.g. religious or cultural reasons), or poorly planned vegetarian or vegan diets during infancy
Provision of highly salted and sugary foods/snacks to infants
Provision of unsuitable supplementary fluids to infants such as tea or carbonated drinks. Also, the provision of excessive volumes of sugar containing fluids to infants prior to 6-months
Additions of highly salted and sugary weaning condiments to weaning foods e.g. gravy, salt, sugar, honey
Use of cow's milk as a sole milk drink during the first year of life
Use of the bottle beyond 1 year of age and lack of introduction of a beaker cup to infants from 6 months
Additions of solids to bottled infant feeds
Inclusion of gluten in the diet prior to 6-months
Intentional avoidance of meat during the weaning process

The literature suggests that unhealthful early feeding taste preferences and patterns of feeding behaviour track into childhood and adulthood. Convincing evidence suggests that if mothers conduct one inappropriate weaning practice, they may also be conducting several other unsuitable weaning practices (Daly *et al.,* 1998; Dubois & Girard, 2003b). For instance, a significantly greater proportion of infants who were introduced to lumpy foods prematurely (< 6 months) were consuming snack foods such as crisps and chocolate as well as drinking tea before 6 months of age, mints and sweets after 6 months and fizzy drinks by 15 months (Northstone *et al.,* 2001). Moreover, studies demonstrate that the conduction of inappropriate weaning practices may have longer-term deleterious consequences pertaining to development, growth, nutritional status and morbidity, as described in **Sections 1.2.6.1** to **1.2.6.5**.

1.2.6.1 Early weaning onto solids

Current evidence supports exclusive breast or formula milk as being nutritionally adequate as the infant's sole source of nutrition up to the age of 4-6 months (Hervada & Newman, 1992; Cohen *et al.,* 1994; Pisacane *et al.,* 1995; AAP, 1997; Kramer & Kakuma, 2002). A large body of evidence suggests that early weaning onto solids may have deleterious health implications for the infant in both the short and longer term.

According to Forsyth *et al.,* (1993), early weaning (≤ 12 weeks) was associated with an increased incidence of respiratory illness (e.g. wheeze and coryza) among infants aged 14-26 weeks and persistent cough at 27-39 weeks. An important study performed by Wilson *et al*., (1998) demonstrated that weaning prior to 15 weeks, versus > 15 weeks, increased the probability of respiratory illness (21% versus 10% respectively), wheeze, body fat (19% versus 17% respectively) and weight during childhood. It has also been shown that infants exposed to a diverse solid food diet prematurely (8-12 weeks) are at greater risk of developing eczema (Forsyth *et al*., 1993) and diarrhoeal illness owing to intestinal immaturity (Hendricks & Badruddin, 1992). Research by Fergusson *et al.,* (1990) indicated an increase in the incidence of recurrent and chronic eczema in children aged 10 years who had been introduced to solid food before 4 months of age. Specific examination of an exclusively breastfed atopic population of infants in Finland (n = 135) suggested that atopic eczema and a history of food allergy was reduced at age 1 year in infants exclusively breastfed beyond 6 months, compared with infants who were introduced to solids at 3 months (Kajosaari, 1991). Furthermore, researchers in this area recommend delaying the introduction of solids (4-6 months), exclusive breastfeeding or the use of a hypoallergenic formula as prophylactic management for infants who are at high risk of allergy (Host & Halken, 1990; Zeiger & Heller, 1995). In conflict with these findings however, an examination of early weaning in relation to asthma and eczema risk in 642 children found no evidence for a protective effect of late introduction to solids for the development of preschool wheezing, atopy or eczema (Zutavern *et al.,* 2004).

Nutritionally, the premature introduction to solids may displace valuable key micronutrients, protein and energy supplied by breast or formula milk (Heinig *et al.,* 1993a; Michaelsen *et al.,* 1994; Borresen, 1995; Child Nutrition Panel, 2003), without supplying additional energy (Mehta *et al.,* 1998). Reduced breast-feeding intensity and frequency are further reported consequences (Frongillo & Habicht, 1997). Moreover, early weaning has been shown to interfere with iron absorption from breast milk (Oski & Landaw, 1980; Pisacane *et al.,* 1995), increasing the risks of IDA in these infants.

Physiologically, solid foods increase the renal solute load on the infant's immature kidneys (ESPGHAN, 1982) resulting in the accumulation of excess electrolytes and hyper-osmolar stress. The absence of renal maturity coupled with early weaning, places the infant at increased risk of hypernatraemia, which could result in serious short and long-term complications.

Earlier studies examining reasons for the increasing incidence of coeliac disease implicated the age of introduction to solids, notably early weaning, in influencing the age of presentation of childhood coeliac disease (Kelly *et al.,* 1989). In the early 1970s, a combination of early weaning (2-3 weeks post partum) and the consumption of foods containing wheat as early weaning foods have been suggested as causative environmental factors for the high incidence of coeliac disease in parts of the West of Ireland (Mylotte *et al.,* 1973). More recently, a declining incidence of coeliac disease and transient gluten intolerance in Somerset, UK have been associated with the later introduction of dietary gluten, increased use of gluten free weaning foods as well as an increased incidence of breastfeeding (Challacombe *et al.,* 1997).

Several observational studies support the findings that early introduction to solid foods may result in a heavier child (Ferris *et al.,* 1980; Forsyth *et al.,* 1993; Wilson *et al.,* 1998), however, this finding was not replicated by other investigators (Davies *et al*., 1977; Wilkinson & Davies, 1978). Previous research confirms an association between early weaning either at, or before 12 weeks, and heavier infants at 26 weeks (Forsyth *et al.,* 1993). Baker *et al*., (2004) found that infants weaned prior to 16 weeks gained significantly more weight during the first year of life. A prospective randomised trial conducted in the UK (Morgan *et al.,* 2004a) found that term infants weaned ≤ 12 weeks were heavier, longer and had a larger head circumference at 12 weeks of age than those weaned after 12 weeks, however no differences were observed between the two groups at 18 months. Despite the fact that no apparent differences are observed in infant size at 18 months between those infants weaned ≤ 12 weeks or > 12 weeks, this does not preclude the later emergence of programmed effects, perhaps influencing the development of overweight and obesity. This is clear from a hallmark study conducted by Wilson *et al.,* (1998), reporting increased body weight and fatness (19% versus 17%) at age 7 years in children who had received solids prior to 15 weeks versus those weaned >15 weeks, despite the fact that the investigators found no apparent effect on weight at the 2 year follow-up. Such findings highlight the longer-term deleterious health implications of early weaning tracking into childhood, creating greater support for the adherence to best weaning practices including the timely introduction of solids during infancy.

1.2.6.2 High fat and sugar-containing weaning foods

Obesity has become the most prevalent childhood disease in Europe, with an estimated 300,000 Irish children being overweight and obese. This figure is projected to increase annually by 10,000 (Southern Area Health Service Executive, 2005), presenting a major public health challenge. According to the WHO (2003a), childhood obesity is a 'global epidemic'. Health problems associated with overweight in childhood include high blood pressure, high cholesterol, orthopaedic disorders, Type 2 Diabetes Mellitis (Haines *et al.,* 2007) and psychosocial disorders (Gidding *et al.,* 1996; Dietz, 1998; Rosenbloom *et al.,* 1999; Freedman *et al.,* 2001). Moreover, research has highlighted the link between overweight children and obesity in adulthood (Nieto *et al.,* 1992) and it is established that overweight children are more likely to become overweight and obese adults (Serdula *et al.,* 1993; Whitaker, 1997; Dietz, 1998). Evidence confirms an association between overweight at age 5 years of age with macro-nutrient intake at 1 year (Scaglioni *et al.,* 2000). Of national significance, paediatricians in Ireland are expressing concern that overweight may be an issue among toddlers (Gill, 2007). According to Nelson *et al.*, (2004), 31% of 2 year olds in the USA were found to be overweight or at risk of overweight. Although research has focussed less attention on the diet during infancy and toddlerhood, increasing global obesity levels during childhood necessitate and indicate the importance of considering diet and energy balance during early life. Moreover, it has been argued that early recognition and prevention efforts are key in addressing public health issues, and for some children, identification of overweight or obesity at age five may be too late (Nelson *et al.,* 2004). According to Reilly *et al.*, (1999), overweight and obesity have their origin in childhood and, thus, efforts to prevent obesity should begin during these years.

Previous studies assessing the nutrient adequacy of infant diets alert us to the possibility that some infants may be consuming excessive energy intakes as early as

6-months (Devaney *et al.,* 2004). Although preferences for sweet tasting foods are innate, early and repeated exposures to specific foods have been shown to enhance their acceptability to children (Birch & Marlin, 1982; Sullivan & Birch, 1994). Skinner *et al.*, (2004) suggested that delaying the introduction of, and exposures to foods low in nutrients and high in energy may be wise during periods when many preferences are formed. Research involving the follow up of overweight children into adulthood over a 40-year period led to the recommendation that weight-reducing methods should commence during early life (Mossberg, 1989).

Although the complex origins of obesity are multi factorial in aetiology, excessive energy intakes relative to energy expenditure during any stage of the life cycle would contribute to an increased prevalence of overweight and obesity.

Inappropriate use of sugar-containing fluids and dental health

Dental caries have been identified as the single most common chronic childhood disease, being five times more common than asthma and seven times more common than hay fever (National Institutes of Health, 2000). The relationship between early diet and dental health during the first year of life is well established. The frequency and duration of exposure of first teeth, developed during the first 6-months, to sugars in foods consumed, is cited as being a determinant of caries development (Rugg-Gunn & Nunn, 1999). The terms 'squash-drinking syndrome' (Hourihane & Rolles, 1995) and 'nursing bottle syndrome' are terms used in the paediatric domain, to describe the inappropriate regular use of sugar containing drinks among infants and toddlers, which can result in extensive and rapid tooth decay (Whitney *et al.,* 2001). Moreover, previous studies suggest that there is an increased consumption of sugar-containing supplementary fluids such as diluted squashes and juices by young infants (Hourihane & Rolles, 1995; Petter *et al.,* 1995; Dennison, 1996).

1.2.6.3 Additions of solids to infant bottled milk feeds

All infant feeding guidelines discourage the additions of solid foods to the infant's bottled milk (breast or formula) feeds to prevent excessive weight gain (Shaw & Lawson, 2007; Thomas & Bishop, 2007), dental caries development (Rugg-Gunn & Nunn, 1999) and lazy feeding. According to Brown (2005), this practice may result in the introduction of solid foods before the infant has developed the skills to eat from a spoon. Furthermore, solid feeding from a bottle may increase the risks of choking particularly if infants are left to feed unattended, and may result in feeding issues such as decreased acceptance of solids from a spoon later on (FSAI, 1999).

Despite the well-publicised guideline to avoid any additions of solids to bottled infant feeds in public health weaning leaflets, some mothers are still known to conduct this practice (Heinig *et al.,* 2006). According to Crocetti *et al.*, (2004), 31% of mothers added cereals to infant feeds prior to 4 months. Among a sample of Australian mothers, Retallack *et al.*, (1994) found that mothers added 'crushed biscuits' to infant milk drinks. In a sample of Pakistani mothers in the UK, 'increased acceptance of infant foods' was one reason reported by mothers who added solids to infant bottled feeds (Sarwar, 2002). The extent to which this is a common practice among mothers in Ireland is not known.

Additions of inappropriate condiments to weaning foods

Home prepared 'modified' infant foods should be free from any extra salted or sugared additional condiments including salt, gravy, sauces, stock based dilutions, sugar, honey or sweeteners. It is less likely that such condiments are added to commercially prepared baby foods, as these are 'ready to eat' foods. Additions of salt, or salt containing foods such as gravy or stock mixtures, should be avoided owing to the infant's physiological inability to excrete sodium efficiently thus increasing the risk of hypernatraemia (Department of Health UK, 1994). It is also known that preferences for salt can be established early in life (Harris & Booth, 1985). Furthermore, high salt diets have been associated with the development of hypertension and strokes in adults (Elliott *et al.,* 1996). It is also widely acknowledged that the addition of refined sugars to infant foods may lead to increased risk of dental caries development and excessive weight gain (Thomas & Bishop, 2007). It is thus important that infants do not develop a preference or liking for sweet tastes due to being offered sweetened foods and drinks, particularly between meals.

Despite the adverse short and longer-term effects of adding highly salted and sugared condiments to the infant weaning foods, few studies have documented the extent to which mothers conduct such an inappropriate practice. The fact that such practices may be socio-economically graded and that mothers may be reluctant to admit to such activities makes it difficult to examine these issues.

1.2.6.4 Use of whole cow's milk during infancy

The use of cow's milk as a sole source of nutrition during the first year of life is considered nutritionally inappropriate and sub-optimal owing to its high concentration of casein, sodium, potassium, calcium and phosphate levels, relative to infants' requirements (FSAI, 1999). In addition, cow's milk is low in energy and has a poor vitamin D and iron content (AAP, 1992), the latter of which predisposes the infant to IDA (Tunnessen & Oski, 1987; Mills & Tyler, 1992). Furthermore, the use of cow's milk prior to 6 months has been shown to contribute to increased gastro intestinal blood loss (Ziegler *et al.,* 1990) and an undesirably high renal solute load at 1 year of age (Foman, 2001).

Although IDA of infancy has declined in many countries as a result of improved feeding practices, the condition remains relatively common (Oski, 1993) particularly in infants from inner cities and ethnic minorities (Fairweather-Tait, 1992).

A previous report indicated that even mild IDA of greater than 3 months duration can have a long-term detrimental influence on mental and psychomotor development (Lozoff *et al.,* 1991). Convincing evidence identifies the early introduction (<1 year) of cow's milk as an independent risk factor for the increased prevalence of IDA at age 12 months (Penrod *et al.,* 1990; Harbottle & Duggan 1992). The Euro Growth study found that 2.3% of 12-month old infants in 11 European areas had IDA (Male *et al.,* 2001). Similarly, Duggan *et al.*, (1991) cited that the highest prevalence of anaemia was between 21 and 24 months.

According to Freeman *et al.*, (1998), Irish infants (n = 92) were consuming cow's milk as early as 2 months (2%) and 7% by age 6-months. A regional Irish study (n = 218) revealed that the mean age of commencing cow's milk was 31 weeks and by 1 year, 49% of infants were consuming cow's milk (Hurley & Fogarty, 1992). In the UK, 8% of infants were consuming cow's milk in place of infant formula by 8-9 months (Hamlyn *et al.,* 2002). Similarly in the U.K., 2% of infants were fed whole cow's milk at 6-months of age; this figure increasing to 17% at 9 months and 45% by the end of the first year (Savage *et al.,* 1998). Although the use of cow's milk during the first year is not as commonplace as reported in previous decades, it remains important to ensure this pattern is continued in our current population.

1.2.6.5 Inclusion of gluten prior to 6-months

The inclusion of gluten containing foods, such as biscuits, rusks and cereals, in the diet before 6-months is considered an unfavourable practice owing to the high allergenicity of such foods (FSAI, 1999). Delaying the introduction of solids beyond 4 months may confer benefit in families with a history of atopy or gluten enteropathy (Kelly *et al.,* 1989) and generally may reduce the occurrence of coeliac disease among infants (COMA, 1994). Despite this recommendation, Daly *et al.*, (1998) reported that a significant proportion of infants in the UK were offered gluten-containing foods (41% rusks and 1% Weetabix) as first weaning foods. Another study from the UK demonstrated a similar practice, highlighting that the provision of gluten-containing cereals to infants as an introductory weaning food was a common practice among Pakistani mothers in the UK (Sarwar, 2002).

1.2.7 Factors affecting weaning practices

Several socio-economic, psychosocial and attitudinal determinants have been identified as influencing weaning practices. Precise knowledge of these predictors in the Irish-specific context is essential in advising mothers, and in developing strategies to promote healthy infant feeding practices. Maternal perceptions and principal influential sources are factors that should also be explored when investigating reasons for feeding decisions. The significant influence of family and friends on mothers' infant feeding decisions and practices is well documented in the literature (McClennan-Reece, 1993). In particular, the maternal grandmother can negatively impact on weaning practices by advising their daughters to '*add cereal to the bottle because the baby cries at night'* or encouraging them to *'fatten the baby up'* (Carruth & Skinner, 2001). Moreover, it has been indicated that not all parents accept the advice of health professional concerning the weaning diet (Pridham, 1990).

Early weaning onto solids has been associated with formula feeding (Wright *et al.,* 2004), maternal perceptions of perceived infant hunger (Savage *et al.,* 1998) and adherence to maternal 'intuition' (Daly *et al.,* 1998). Other work confirmed that early weaning appears to be influenced by mothers' perceptions of their baby's needs (Alder *et al.,* 2004). Canadian research found that infant developmental cues may not be taken into account when mothers are deciding on the timing of weaning (Kwavnick *et al.,* 1999). Savage *et al.*, (1998) argued that despite the importance of parental attitudes in influencing weaning practices, few studies have comprehensively examined the extent to which attitudes affect maternal behaviour.

Furthermore, weaning patterns and the timing of introduction to solid foods differ between formula and breast fed infants. An examination of the weaning practices in these feeding groups demonstrated that formula fed infants were more likely to be weaned earlier, to have consumed commercial infant drinks and were less likely to have consumed fruit and vegetables compared to breastfed infants (Noble & Emmet, 2006). Formula feeding is cited as a strong predictor of earlier weaning onto solids in term (Bronner *et al.,* 1999) and preterm infants (Norris *et al.,* 2002). It has been suggested that since formula feeding, younger maternal age and maternal smoking are consistently found to be associated with early weaning, 'less positive health behaviours' may be common among the mothers who wean early (Fewtrell *et al.,* 2003).

1.2.7.1 Socio-economic determinants

Significant associations exist between the types of foods and drinks consumed by infants and the socio-demographic characteristics of their mothers. The literature confirms that mothers with lower educational attainment levels are less likely to comply with infant feeding recommendations (Liaqat *et al.,* 2007). According to Northstone *et al*., (2002) the increased provision of unsuitable supplementary fluids to infants such as carbonated drinks and low-energy drinks was more prevalent among less educated mothers. An examination of socio-economic determinants of feeding practices in the USA (n = 2,515) concluded that infants of mothers who had a third level college education were more likely to consume fruit, and less likely to consume sweetened beverages, desserts and sweets (Hendricks *et al.,* 2006). A UK government survey (Infant Feeding 2000) confirmed that socio-demographic factors hugely influenced the timing of introduction to solids concluding that: lower age of mother leaving full time education, lower social class of the partner, lower maternal educational level and smoking habits were associated with early weaning (Hamlyn *et al.,* 2001). Moreover, Horta *et al.*, (2001) found a higher odds ratio for weaning before 3 months among mothers who smoked than among non-smoking mothers. According to Wharf *et al.*, (1997), smoking in the household was identified as the only socio economic predictor of early introduction to cow's milk.

Current evidence thus strongly points to the inclusion and investigation of socio-economic variables as being a crucial component of explorative, descriptive and predictive models in weaning and infant feeding-related research. Moreover, adjusting for key socio-economic factors in statistical models is a necessary measure to ensure true conclusions, and a more accurate interpretation of data (Bauchner *et al.,* 1986).

1.2.8 Irish-based weaning research

The last Irish-based infant feeding study (Freeman, 1996) revealed the occurrence of several unsuitable weaning practices such as early weaning onto solids by 12 weeks post partum (68% of infants). Furthermore, this study highlighted that Irish infants were consuming cow's milk as a main milk drink, which is a known risk factor of IDA, as early as 2 months (2%) and 7% by age 6-months (Freeman, 1996). Of greater concern was the finding that 2.6% of Irish infants were found to be clinically anaemic at age 12 months, 9.2% at 24 months and 8% at age 3 years. There is a clear need to re-investigate the timing of introduction to solids and assess improvements in weaning practices almost a decade later.

Irish-based research has never examined the snacking patterns of 6-month old infants in Ireland, nor has research focused on the prevalence of inappropriate weaning practices such as the addition of unsuitable condiments to weaning foods or quantified the consumption of supplementary fluids in the diets of 6-month old infants. It is thus vital to evaluate and document compliance with best infant feeding practices at a national level and provide data on the extent of non-compliance relative to current recommendations.

1.2.9 Conclusions

International and national infant feeding recommendations clearly and consistently outline the nutritional and developmental transitions during the weaning process (see **Appendices V** and **VI**). These recommendations are underpinned by relevant evidence-based functions being predominantly concerned with nutritional and developmental elements. The importance of adhering to best weaning practices, in an age-specific context, has been well documented in the literature. Undoubtedly, the weaning process is a sensitive 'window of opportunity' for the introduction of new foods, flavours, tastes and consistencies in infant diets. Failure to meet weaning milestones has been shown to impact deleteriously on infant health and parental anxiety, possibly demanding intense nutritional, medical and public health input and support.

Several health and nutrition related complications have been linked with the diet during infancy. Of current global concern, rapidly rising childhood obesity rates alert researchers and health professionals to the importance of monitoring, tracking and documenting the diet from infancy, and beyond (Snethen *et al.,* 2007). Research suggests that rapid early growth rate during infancy may be implicated in increasing the risks of early overweight and obesity (Dennisson *et al.,* 2006). Early introduction to solid foods has also been shown to contribute to increased body fatness and body weight during childhood (Wilson *et al.,* 1998). Furthermore, food preferences developed in infancy set the stage for life long food and eating habits (Brown, 2005).

Investigating weaning patterns and practices will yield valuable data and may influence how we relay infant feeding information to mothers. The last comprehensive Irish-based study that specifically examined weaning practices was conducted in 1996 (Freeman, 1996). The fact that no data exist on weaning practices in Ireland during the intervening period is of particular concern. The FSAI (1999) acknowledged that there is a need for more Irish research into the introduction of complementary foods and remarked that current data are limited, data collection methods are not standardised and that some data only focus on socio-economically disadvantaged communities. International evidence highlights that despite widely published weaning guidelines to mothers and a greater access to weaning information sources including the media, inappropriate weaning practices among mothers still exist.

Chapter 2

General Methodology, Aims and Objectives

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2.1 Introduction

The methods common to **Chapters 4** to **7** are described in this section. Specific details relevant to the methodology in subsequent chapters are described in more detail within those sections. Consistent methods were performed on the sample throughout the study.

The study investigator was a research dietitian who had previously trained and worked as a paediatric dietitian in the clinical setting. The work reported in this thesis including the design and administration of the questionnaires, conduction of the dietary assessments, anthropometric measurements of term healthy infants at 6-weeks and 6-months, data entry and analysis was carried out by the author (R.C. Tarrant).

2.2 Aims and objectives

The overall aim of this study was ‘to investigate the diet of a sample of infants born in Dublin during the first six months of life’. A number of specific objectives stem from this general aim as illustrated in **Figure 2.1.**

Figure 2.1. Study aims and objectives

Aim: To investigate the diets of infants born in Ireland during the first 6-months of life

Objective 1: To document the breastfeeding initiation rate among National and Non-National Mothers

Objective 2: To report the breastfeeding prevalence rates from birth until 6-months among National and Non-National Mothers

Objective 3: To investigate the determinants of breastfeeding initiation in a sample of National Mothers

Objective 4: To investigate the determinants of 'any' breastfeeding at 6-weeks post partum in a sample of National mothers

Objective 5: To profile the socio-economic characteristics of Mothers who were breastfeeding at 6-months

Objective 6: To describe the weaning practices in a sample of healthy term infants in Dublin

Objective 7: To determine the factors that predict the occurrence of inappropriate weaning practices

2.3 Ethical approval

Ethical approval was obtained from the ethics committee of the Coombe Women's Hospital (reference number 2004-01, approved on the 13th April 2004) and the Dublin Institute of Technology (reference number 05/04, approved on the 17th February 2004). Following verbal consent, mothers received a patient information leaflet detailing the study aims, requirements and follow-up details, along with a copy of the written consent form. Informed written consent was obtained from each mother prior to study participation.

To fulfil the ethics approval requirement, all mother and infant medical notes, along with the computerised hospital patient system had to be checked prior to contacting mothers to ensure the delivery of a 'live' infant. While every effort was made to ensure that the infants were alive upon contact with mothers at 6-weeks and 6-months, it was also acknowledged that there was a possibility that infant deaths may have occurred prior to this contact i.e. from the time the notes were checked to the time the mother was contacted. The ethics committees also stipulated that in the event of any suspected harm to infants or mothers, reported neglect or the conduction of harmful feeding practices to infants, it was mandatory that the investigator inform a member of the paediatric medical team in the hospital as well as the mother's public health nurse and GP.

Confidentiality was emphasised as being a crucial component of the study. Medical information and interview documents were numerically coded and mothers contact details were filed separately. Mothers' names corresponding to each case number were recorded in a separate document and were known only to the investigator. Copies of the patient information leaflet and consent form for the study can be seen in **Appendix VII.**

2.4 Study design

This study was designed as a prospective, observational study involving the recruitment of pregnant women from public, semi-private and private antenatal clinics. Eligible mother-infant pairs were subsequently followed up at 6-weeks and 6-months post partum. The study protocol stipulated that infants had to be followed up within a time of 7 days after turning 6-weeks and 6-months. All efforts were made to maintain consistency and to comply with this timeframe, however, owing to the availability of mothers, some mother/infant pairs were followed up beyond this time point (minimum-maximum 24-26 weeks post partum). Recruitment of mothers and follow-up took place from June 2004 to October 2006.

2.4.1 Setting

The study population was recruited from a single maternity hospital setting, the Coombe Women's Hospital[†] in Dublin 8, Ireland. Thus, the majority of study participants lived in the Dublin region; however some mothers lived in the outer county Dublin region. The hospital is one of the three large maternity hospitals in Dublin, recording the highest birth rate in 2005 relative to other Dublin and national maternity hospitals, as summarized in **Table 2.1**.

[†] As of January 2008, and following completion of this study, the Coombe Women's Hospital officially became known as 'The Coombe Women and Infants University Hospital'. According to the Master, Dr. Chris Fitzpatrick (2008), the reason for this change is to reflect the breadth, depth and complexity of clinical and academic activity on the hospital campus.

Table 2.1. Total number of Mothers who delivered infants weighing > 500g in the three main Dublin Maternity hospitals from 2004-2006

Maternity hospital	2004	2005	2006
* Coombe Women's Hospital	7,877	7,787	8,084
^ National Maternity Hospital	8,318	7,493	7,985
$ The Rotunda Hospital	6,582	6,695	7,325

* Coombe Women's Hospital Annual Clinical Reports: 2004, 2005 and 2006
^ National Maternity Hospital Annual Clinical Reports: 2004, 2005 and 2006
$ The Rotunda Hospital Annual Clinical Reports: 2004, 2005 and 2006

2.4.2 Sampling methods

The proportions of mothers attending public, semi-private and private clinics in the Coombe Women's Hospital, from 2004 to 2006, are shown in **Table 2.2**. To fit the proportion of mothers attending the public, semi-private and private clinics, and ensure the recruitment of a wide socio-economic spread of participants, this study thus aimed to recruit over fifty percent of mothers from public ante natal clinics.

Table 2.2. Proportion of Mothers who attended public, semi-private and private clinics in the Coombe Women's Hospital, Dublin from 2004-2006

*Attendance to specific health insurance related clinics	2004	2005	2006
Attendance to public clinics	58%	56%	58%
Attendance to semi-private clinics	16%	17%	17%
Attendance to private clinics	26%	27%	25%

* Coombe Women's Hospital IT and Statistical Department Reports (2004-2006)

The study did not aim to recruit a nationally representative sample of women; however, in order to recruit a representative sample of women attending the hospital, the majority of recruitment time was apportioned to the public antenatal clinics and to a lesser degree, semi-private and private clinics, in an effort to match the desired socio-economic profile as closely as possible. Over-representation of higher socio-economic groups has been documented as a major limitation of infant feeding studies, which, therefore, do not reflect the true prevalence of feeding practices (Ward *et al.,* 2004). Every effort was made to represent the three health insurance categories in accordance with the hospital's annual figures and thus avoid any selection bias.

2.4.3 Recruitment of subjects

The 'convenience' sample of women recruited, involved the daily attendance of the investigator in the waiting rooms of both morning and afternoon, public, semi-private and private ante-natal clinics. This limited selection bias towards any particular day of the week (Monday to Friday clinics), a particular obstetrician, or morning/afternoon-timetabled clinics. The study time frame incorporated recruitment over all four seasons, thus limiting any seasonal variation. The recruitment procedure was facilitated by the fact that the hospital had scheduled weekly public, semi-private and private clinics with separate, clinic-specific waiting areas. To minimize any unconscious selection, the investigator, prior to attempting to recruit mothers, did not collect their socio-demographic details.

In a consecutive fashion across the seating arrangements in each clinic and pending study eligibility, each pregnant mother was individually and consecutively informed about the purpose of the research and the level of their involvement. Although expectant mothers were aware that the study aimed to investigate the diets of infants born in Ireland, they were not provided with specific advice on infant feeding or weaning guidelines. If this information was requested the midwives were consulted and involved.

Inclusion criteria upon recruitment

- ✓ Pregnant women ≥ 24 weeks gestational age (information confirmed *per* mother's medical notes and verbally reported by mothers), who at the time of recruitment were planning to reside in Ireland for at least 6-months post partum. Mothers ≥ 24 weeks gestational age were recruited for the purpose of optimising follow-up due to improved survival of the infants after 24 weeks gestational age.
- ✓ Mothers who were willing to consent to study participation with subsequent follow-up at 6-weeks and 6-months post partum.

Exclusion criteria upon recruitment

- ✗ Multiple birth pregnancies were excluded from study participation, along with any mother experiencing a 'high risk' pregnancy (defined by early bleeding in pregnancy warranting regular scanning and obstetric monitoring), as reported by the hospital midwives present in the clinics or *per* the mother's medical notes.

All mothers, regardless of nationality or level of spoken English were invited to participate in the study. Mothers were assured of complete confidentiality and that all documents pertaining to their medical history and responses to questionnaires were numerically coded. There was no incentive for participation in the study; however, mothers were informed that the research findings would highlight problems and deficiencies in our current health system, thus helping to improve hospital and community support strategies for future mothers. Given the mother's willingness to participate and following written consent, the first questionnaire was administered.

Hospital staff and midwives were aware that this study was being undertaken. The investigator was informed of any mother with a 'high risk' pregnancy, or mothers who had a scan that warranted close medical monitoring by the midwives on duty. In view of the medical and emotional sensitivities surrounding these pregnancies, and the fact that they were 'high risk', such mothers were not approached to participate in the study.

Selection bias was limited by strict compliance to the aforementioned methods. The researcher introduced herself individually to mothers as a *'student working in the hospital'* to avoid any biased reporting. Furthermore, care was taken to avoid prompting mothers' answers towards any specific feeding choice.

In addition, the investigator worked consistently during the recruitment and follow-up periods, including late in the evenings and during the weekends. Some days (Monday-Friday) were solely dedicated to the recruitment of mothers, while other days were split between following up mothers and documenting data from the medical notes.

2.4.4 Non-respondents

It has been suggested that non-respondents may account for a substantial proportion of the study sample and are therefore highly likely to have a significant impact on study findings, thereby influencing the conclusions that follow (Shepard *et al.*, 1998). Tiredness or anxieties related to the pregnancy at the time of recruitment, or unwillingness to be followed up post partum were the reasons given by the mothers who declined study participation. Information pertaining to maternal age, smoking status and feeding intention at that point of the pregnancy was obtained from these prospective mothers.

2.5 Design of questionnaires

Study questionnaires for the purpose of quantitative surveys are recognized as key research tools enabling the collection of specific information. This study involved the use of three semi-structured questionnaires (see **Appendices VIII**, **IX** and **X)** that were constructed following thorough research of national and international infant feeding literature and questionnaires that had been previously validated. In order to elucidate and explore current knowledge gaps in the infant feeding domain in Ireland, a range of areas were chosen from the literature as being important and relevant to our population. Several themes and recommendations from existing research and infant feeding questionnaires (Howie *et al.,* 1990; Frazier *et al.,* 1998; FSAI, 1999; Labbock *et al.,* 2006; Horodynski *et al.,* 2007) that warranted more in-depth examination such as maternal perceptions and attitudes (Synnott & Bogue, 2004), ethnic considerations (Hamlyn *et al.,* 2002), 'partner involvement factors' (AAP, 2005) and 'employment status of mothers' (Earland *et al.,* 1997; Galtry, 2003; Bakoula *et al.,* 2007) were highlighted as being of prime importance for inclusion in the questionnaires. Such issues may not have been as relevant to the Irish population a decade ago. The questionnaires were written in clear, unambiguous user-friendly language consisting of open and closed ended questions, and were designed to elicit information pertaining to the mothers' infant feeding practices and attitudes as well as the beliefs held by the mother about feeding.

2.5.1 Pilot study

Prior to study commencement, the three semi-structured questionnaires were tested on three separate pilot groups, consisting of twenty subjects per group. This exercise ensured a clear interpretation and understanding of questions, assessed how 'user-friendly' the layout of the questions was presented, and allowed an estimation of the time required for administering each questionnaire. Any questions, terms or phrases that the pilot study highlighted as being vague or unclear were amended accordingly.

2.5.2 Recruitment

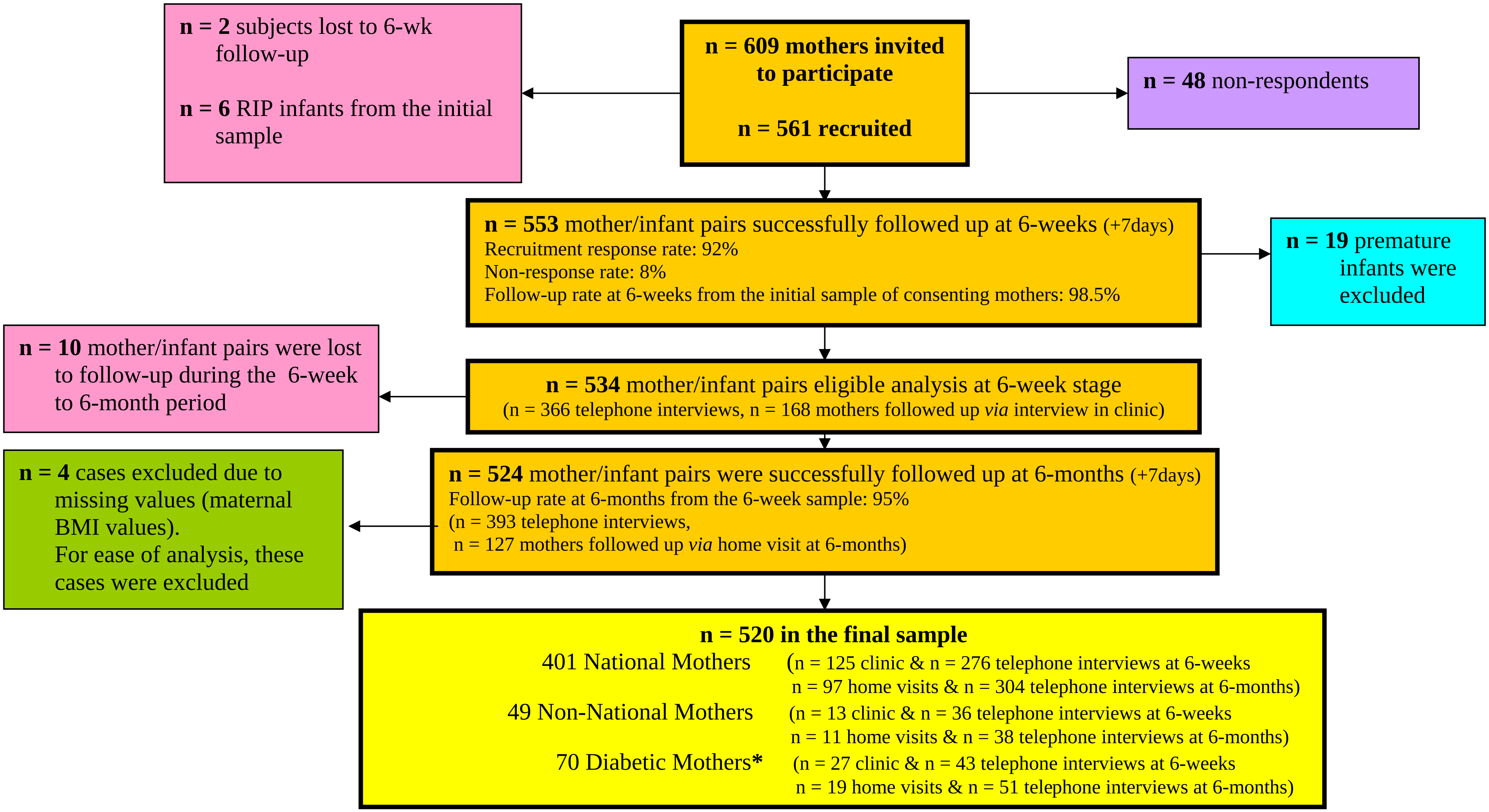
To ensure adequate statistical power and allow for a potentially high drop-off rate, the investigator set out to recruit approximately 500 mothers. In the event, a total of 609 expectant mothers in their third trimester of pregnancy were invited to participate in the study, 561 of whom agreed to participate, having given signed consent. At 6-weeks and 6-months, the majority of mothers, 366 and 393 mothers respectively, were followed up *via* telephone. Of the remaining mothers, 168 were followed up in the hospital clinic *via* a face-to-face interview at 6-weeks and 127 of these were followed up *via* a home visit at 6-months. **Figure 2.2** outlines the cohort profile with subsequent follow-up.

Exclusions:

In total, **41 cases** were excluded from the study owing to:

- **6 infant deaths**: 1 post natal death due to ‘Hyperplasia Left Heart Syndrome’, 3 intra uterine deaths and 2 miscarriages
- **19 premature infants** who did not meet the 6-week follow-up criteria (see **Section 2.6.2**)
- **12 mothers** who were lost to follow-up
- For ease of analysis and for data completeness, 6 mothers were excluded due to missing maternal reported BMI values, however since 2 of these mothers were lost to follow-up this resulted in the exclusion of **4 cases** due to missing BMI values.

Figure 2.2. Cohort profile from recruitment to the 6-week and 6-month follow-up



***** The Diabetic mothers consisted of Type I (n =52) and Gestational Diabetics (n=18). The Diabetic population was recruited from a specific Diabetic Clinic in the Coombe Women's Hospital, however it was beyond the scope of this thesis to examine the feeding practices of these mothers; further analysis will be undertaken at a later stage.

2.6 First contact with mothers

Following signed consent, mothers completed the first self-administered semi-structured questionnaire during a time frame of 20-30 minutes while waiting in the ante natal clinic. To maximise the response rate and avoid bias due to illiteracy, some questionnaires were interviewer-assisted in cases of poor written understanding of English or reported illiteracy, particularly among non-Irish nationals and members of the Travelling Community. The investigator was available to mothers in clinics to provide any assistance or clarification in completing the questionnaires. Some terms were paraphrased for mothers who did not comprehend the meaning, such as ‘supplements’ or ‘influenced’.

Information was obtained from the mothers’ medical notes relating to their medical and obstetric status. For the purpose of study follow-up, general practitioner (GP) and Next of Kin contact details were also recorded (see **Appendix VIII, Section D**).

2.6.1 Self-administered questionnaire 1

The first self-administered questionnaire (see **Appendix VIII**) was designed to record key ante natal infant feeding information including maternal infant feeding intention, infant feeding history (pertaining to multi-parous mothers), maternal attitudes and exposure to breastfeeding as well as mothers’ perception of partners’ infant feeding preference. Socio-demographic factors were identified including maternal/paternal occupation, maternal/paternal level of educational attainment and demographic details, maternal age and maternal employment status. Maternal health behaviours during pregnancy were recorded including smoking status, alcohol consumption, folic acid and vitamin/mineral supplementation practices. Maternal documentation of smoking status, folic acid supplementation practices (commencement of the supplement) and alcohol consumption patterns, as documented in the questionnaires, were crosschecked with the information in the mothers' medical notes.

The questionnaires were checked by the researcher to ensure completeness and to clarify any anomalies. The investigator requested the completion of any 'missing value' sections, with the exception of cases where mothers were reluctant to give specific information or where information was deliberately omitted. Such omissions were coded as '9999' in the statistical database denoting a 'missing value'.

2.6.2 Post partum follow-up criteria

Mother-infant pairs who were eligible for post partum follow-up had to meet the following criteria:

Inclusion criteria

- ✓ All mothers who bore a healthy, term (≥ 37 weeks gestational age), singleton baby weighing ≥ 2.5 kg at birth.
- ✓ Mother's willingness to be followed-up.

Exclusion criteria

- ✗ Mothers & infants were excluded from post partum follow-up if the infant required special medical treatment in the neonatal unit, in cases of congenital abnormalities or artificial feeding, or general medical intervention for any illness that would be considered an anomaly in a normal population of mothers and infants post birth. This information was obtained from the medical notes.
- ✗ Exclusion of infants requiring a medically prescribed diet post delivery e.g. metabolic disorders.

Prior to contacting mothers at 6-weeks and in compliance with the ethics requirement, all infant medical notes were examined to confirm the delivery of a healthy, live infant. In addition, the hospital records were consulted to cross check the status of the infant notably, 'RIP' or 'LIVE'. Causes of infant death were documented. Standardised obstetric details were obtained from the mothers' medical notes including:

- ✓ Type of delivery
- ✓ Use of anaesthetic
- ✓ Duration of maternal post partum hospital stay

Standardised information relating to the infant characteristics and birth details were recorded from the infants' medical notes including:

- ✓ Gender of infant
- ✓ Date of birth
- ✓ Gestational age and size at birth (small, appropriate or large for gestational age)
- ✓ Presence of neonatal jaundice
- ✓ Birth measurements including birth weight, length and head circumference

2.7 Follow-up protocol at 6-weeks

All eligible mothers were contacted by telephone and were requested to attend a hospital clinic appointment in the baby clinic of the Coombe Women's Hospital. Mothers who had a pre-arranged 6-week check-up appointment with the paediatrician in the Coombe Women's Hospital were also given an appointment for the 6-week study interview, coinciding with the clinical check-up. When necessary, appointments were arranged with mothers specifically for the study. Adhering to study protocol, mothers were telephoned on five different occasions and at different times during the day (e.g. morning or evening) including a weekday and weekend day, before they were deemed 'uncontactable'. In cases where mothers were uncontactable or telephone numbers (home or mobile numbers) were inactive, the local GP or/and mother's 'Next of Kin' were contacted to provide an updated mobile/home number, or to confirm mother's current contact details, including mother's mobile and home telephone numbers as well as her current home address. GP and 'Next of Kin' contact details were recorded from the mother's medical notes upon the first contact with mothers.

Following five attempts on five different episodes (e.g. morning, evening, night-time or weekday versus weekend day) to contact mothers *via* telephone, a Coombe Women's Hospital headed letter was posted to the home address requesting that she call the researcher for the purpose of study follow-up. Following a non-response from 5 telephone attempts and a postal non-reply to the letter, the mother was excluded from the study follow-up.

2.7.1 Six week interviewer-administered questionnaire 2

A face-to-face interviewer-administered interview in the hospital clinic was the ideal and preferred contact with mothers at 6-weeks post partum, within a time frame of 6 weeks plus 7 days as agreed in the study protocol. The average duration of the 6-week interview was 20 minutes, however, if mothers had a poor understanding of English the interview time was lengthened to a maximum of 30 minutes. A specific room was allocated to the study in the hospital baby clinic, which allowed uninterrupted communication with mothers.

In cases where mothers were unable to attend the hospital clinic appointment due to other commitments or inability to attend the clinic, interviewer-administered interviews were conducted by telephone. Although, the different interview methods raise issues of standardization across the study methodology, obtaining and recording the data was nevertheless successfully achieved by the one investigator.

2.7.2 Data recorded at the six-week interview

The second interviewer-administered questionnaire conducted at 6-weeks (+7days) post birth aimed to collect comprehensive information on mothers' infant feeding methods and practices along with the reasons for such feeding choices (see **Appendix IX)**. As part of the assessment, mothers were questioned on their infant's milk feeding status and/or the inclusion of solid foods in their infant's diet at this time. Infant feeding status was collected at a moment in time *via* maternal 24-hour recall of the infant's usual diet at 6-weeks. Formula and breastfeeding-specific information were documented. Any feeding transitions that occurred from birth, during the 6-week time frame were retrospectively recorded:

- ✓ Week of exclusive breastfeeding cessation
- ✓ Week mother introduced water/water based fluids/non-human milk fluids
- ✓ Week of total discontinuation of breastfeeding practice
- ✓ Week solid foods were introduced.

This enabled the precise reporting of infant feeding status at the following chosen time points:

1. Initiation of breastfeeding
2. Feeding method upon discharge from hospital
3. Feeding method at 4-weeks post birth
4. Feeding method at 6-weeks post birth

Mothers were questioned as to their sources of infant feeding information, their perceived satisfaction with the support they received post-discharge, in the community and intrinsically within their family matrix. Maternal attitudes to their chosen feeding practice were assessed along with the reasons for their feeding choices. Maternal employment status and intention to work outside the home was reported. The second interview also documented hospital practices including rooming-in, occurrence of skin-to-skin contact and mothers' satisfaction with the support received on the ward post birth.

2.7.3 Anthropometric measurements

Following a face-to-face interviewer-administered questionnaire with mothers in the clinic, the infant's anthropometric measurements were taken and recorded by the investigator in the baby clinic. In the case of mothers who were contacted by telephone, available anthropometric measurements from the 6-week GP check-up were requested.

Weight

Naked weights were measured using a high specification portable calibrated Seca 835-2 (III) Class III (see **Figure 2.3**) according to EC Directive 90/384/EEC baby/toddler scales (SECA, Barn Street, Birmingham, B5 5QB, UK: supplied by H. Evans & Sons Ireland, specialists in medical weighing) with a weight capacity of 50kg and a graduation of 20g. The scales complied with the European Directive for medical weighing instrument 90/284/EEC. The scales were used exclusively for the purpose of the study and were regularly checked in the clinic against another scale of similar make. H. Evans SECA trained technicians serviced the scales on two different occasions over the study period.

The weighing scales was placed on a level, fixed surface. All infants were naked when they were weighed. Three consecutive weight measurements were taken and the average of the three weight measurements was recorded. All weight, length and head circumference measurements were plotted on the Child Growth Foundation centile charts (Child Growth Foundation 0-1 year centile charts for male and female infants, 1990).

Figure 2.3. Seca 835-2 (III) Class III baby weighing scales

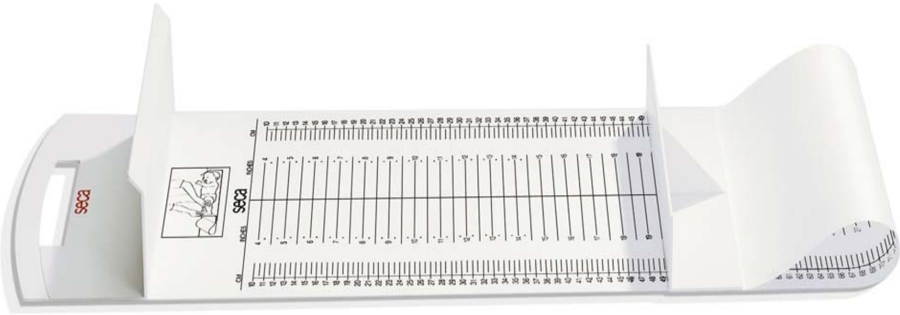
Length

Supine length was measured using a mobile Seca 210 measuring mat (see **Figure 2.4**), specifically designed for babies and toddlers (SECA, Barn Street, Birmingham, B5 5QB, UK). The measuring mat was washable and foldable with a measuring range between 10-99cm and a graduation of 5mm. Mothers were involved in taking the length measurement, notably by pressing gently on the infants' knees to ensure that the legs were straight and that full length was measured. It was ensured that the downward pressure on the infants' knees did not risk hip dislocation. Mothers also distracted the infants and ensured a steady head position with the infants looking directly upwards in the Frankfurt plane[*]. It was ensured that the infant's head was touching the headboard. The moveable footboard of the length mat was drawn upwards by the investigator, as close to the mat as possible, and was placed firmly on the sole of the infant's feet, with particular pressure placed downwards upon the heel. Length measurement was taken to the nearest mm.

There is a strong possibility of inter and intra observer variation when measuring length (WHO Multicentre Growth Reference Study Group, 2006), highlighting the importance of complying with the above methods. Three length measurements were taken and an average measurement was recorded to the nearest mm.

[*] The Frankfurt plane is an imaginary line from the centre of the ear hole to the lower border of the eye socket

Figure 2.4. Seca 210 measuring mat



Head circumference

The head circumference was measured to the nearest 1mm. Measurements were made using a paediatric specific plastic Seca 200 circumference measuring tape (SECA, Barn Street, Birmingham, B5 5QB, UK), as illustrated in **Figure 2.5**. The measuring range was determined to be between 15-200cm with a graduation of 1mm. Head circumference measurements were taken from midway between the infants' eyebrows and the hairline at the front of the head and the occipital prominence at the back. The measurements were taken and recorded on three different occasions and an average measurement was then calculated.

Figure 2.5. Seca 200 circumference measuring tape

2.8 Six month follow-up

Every effort was made to follow-up mothers at 6-months post partum; the majority of whom were followed up by telephone (n = 393). For the collection of accurate anthropometric data by the investigator, most mothers who were followed up at 6-weeks *via* a face-to-face interview in the hospital clinic (n = 168) were followed up by a home visit (n = 127) at 6-months. In addition to the 6-month interview, a home visit allowed the collection of accurate weight, length and head circumference measurements from this specific group of infants (n = 127). Those who did not attend a hospital appointment at 6-weeks were automatically followed up by telephone. To ensure methodological consistency, home visits were conducted by the researcher within a timeframe of 6-months plus 7 days, according to the following criteria:

- ✓ The infants had been successfully followed up in the hospital clinic *via* an interviewer-administered questionnaire within 7 days after turning 6-weeks, in accordance with the protocols outlined in **Section 2.7.**
- ✓ Complete anthropometric measurements were collected including the birth measurements (birth weight, length and head circumference) and the 6-week anthropometric measurements, as taken by the investigator in accordance with the methodology described in **Section 2.7.3.**
- ✓ Mothers were living in the Dublin region (County Dublin), Co. Kildare, Co. Wicklow or Co. Meath.

2.8.1 Six month interviewer-administered questionnaire 3

A face-to-face interviewer-administered questionnaire was conducted with mothers during a home visit at 6-months, within a time frame of 7 days after the infants turned 6 months. Mobile anthropometric equipment allowed the collection of a naked weight, length and a head circumference measurement on these infants, as described in

Section 2.7.3. Mothers who did not meet the criteria for the conduction of a home visit at six months were interviewed by telephone interview.

The six-month questionnaire (see **Appendix X**) elicited information on the 'feeding status at 6-months' using a maternal 24-hour recall of their infant's usual diet. This required specific details such as volume of formula feeds consumed per 24 hours, number of breast or formula feeds consumed per 24 hours and volume of all non-milk fluids offered to the infants. The feeding transitions were retrospectively recorded from the 6-week feeding status through to 6-months, including week of introduction of solids, week mother discontinued breastfeeding or week mother introduced formula feeds. This enabled a categorization of the 6-month feeding status along with the mother's recall of feeding transitions and episodes from 6-weeks to 6-months. The dietary information on weaning was semi-categorised into variables including:

- ✓ Meal frequency per 24 hours
- ✓ Snacking frequency per 24 hours
- ✓ Types of usual snacks consumed and the number of snacking episodes per week
- ✓ Types of supplementary fluids consumed and the estimated volume of these fluids consumed per day
- ✓ The 'usual type of foods consumed' for breakfast, lunch, evening meal and dessert

Weaning practices were documented such as beaker cup use at 6-months, addition of solids to infant bottles, along with additions of unsuitable condiments such as gravy or salt to the weaning foods.

2.9 Socio-demographic data

A number of socio economic markers were collected and used in this study to create proxies for socio economic status, including maternal and paternal occupations, along with level of educational attainment. Educational attainment levels were categorized as completion of education to 1. *Primary/secondary level*, 2. *Vocational/training course* 3. *Third level degree/post-graduate*. Maternal and paternal occupations were categorised according to the social class categories from the UK (Office of Population Census and Surveys: Standard Occupational Classification, 1991) and Irish classification systems (Central Statistics Office: Census 1996). The individuals were classified into one of 8 social classes including a residual 'unknown group' if the mother/father were unemployed or students. A specific group was formed for mothers who were home-makers, or stay-at-home mothers, as it was intended that these mothers be examined separately. For the purpose of statistical analysis, the social classes were further collapsed in a consistent format into more condensed groups across the study population. Following a frequency analysis of the various social classes in the population (both maternal and paternal), the following groups were created as illustrated in **Table 2.3**. Professional workers (social class 1) were grouped with managerial and technical (social class 2) to form *Social Class 1.* The non-manual group was an individual group forming *Social Class 2.* Skilled manual, semi-skilled and unskilled groups were combined to form *Social Class 3*. The '*unknown category*' consisted of mothers and fathers/partners who were unemployed or students and the '*home makers/stay-at-home mothers category*' relevant only to mothers. Since no fathers or partners were reported to have an occupation as a 'home-maker', this category was mother-specific in this thesis.

Table 2.3. Summary of the UK and Irish social class categorizations used in this thesis

1	Professional workers	**Social Class 1**
2	Managerial and technical	**Social Class 1**
3	Non-manual	**Social Class 2**
4	Skilled manual	**Social Class 3**
5	Semi-skilled	**Social Class 3**
6	Unskilled	**Social Class 3**
7	Occupation unknown	**'Unknown Category'**
8	Students	**'Unknown Category'**
9	Home makers/stay-at-home mother	**Home makers/stay-at-home mothers**

2.9.1 Statistical analysis

The data collected from the 3 questionnaires were entered into a database using the Statistical Package for the Social Sciences for Windows version 13.0 (SPSS for Windows, SPSS Inc., Chicago, IL) running on a Dell personal computer. Details of the statistical methods used are described in each chapter (see **Chapters 4, 5, 6 and 7**). Statistical significance was taken at $P < 0.05$. Data are summarized numerically using mean ± standard deviation or median (interquartile range for skewed or non-normally distributed data). Relationships between categorical variables were examined using cross tabulations and the Chi-squared test. For purposes of analysis involving two dichotomous variables, the Yates's continuity correction value was used. For all continuous variables that were normally distributed, comparison of two means was assessed using the Independent-Samples *t-test,* while two non-normally distributed means were compared using the Mann-Whitney *U* Test.

2.9.2 Data handling

In total, 4 cases in the study were excluded from the database due to missing data specifically, maternal BMI values (n = 4). Data are missing for some subjects including infant birth length (n = 19) and birth head circumference (n=17) measurements, owing to incomplete recording in the infant medical notes at the birth. It was decided that these subjects should not be excluded from the database as all the infant birth weights were recorded, thus providing an anthropometric marker for each infant.

To ensure patient confidentiality all mothers were assigned a coded identification number. Contact details were securely filed separately from the medical and study results.

The author was the only individual who entered the data into the SPSS database, fifty percent of which were randomly re-checked for any errors.

Chapter 3

Population Sample

CHAPTER INDEX **PAGE**

3.1 Introduction

The purpose of this chapter is to present the characteristics of the study populations, as well as to describe the characteristics of the cases excluded and those who did not respond, relative to the total population of mothers (n = 450). The two central populations in this study include the national (n = 401) mothers, whose data are presented in **Chapters 4** to **7,** and the non-national mothers (n = 49) whose data are presented in **Chapter 4** and for whom the breastfeeding prevalence rates are described and discussed. Comparisons between the characteristics of these populations are summarized in **Tables 3.1** to **3.4.**

According to Shepard *et al.*, (1998), an examination of the characteristics of the non-responder population enhances our understanding of the determinants of mothers' infant feeding choice and provides information on the representativeness of the sample actually investigated. Failure to include data on non-responder characteristics, feeding intentions and feeding behaviour has been acknowledged as a limitation in previous infant feeding studies (Alexy & Carter-Martin, 1994; Ever-Hadani *et al.*, 1994).

Characteristics of the excluded mother-infant pairs including the premature infants (see **Table 3.6**), the cases lost to follow-up at 6-weeks (n = 2) and 6-month (n = 10) (see **Table 3.7**) and the excluded cases due to missing maternal reported BMI values (n = 6) (see **Table 3.8**) are also described in this chapter. Comparisons are drawn between the key characteristics of these populations and those in the total population of national and non-national mothers (n = 450), for whom complete data were available.

3.2 Comparison of the characteristics of the National (n = 401) and Non-National (n = 49) Mothers

The socio-demographic, maternal health behavioural and infant characteristics of the national and non-national mothers are outlined in **Table 3.1**, **Table 3.2** and **Table 3.3,** respectively. Of the national mothers (n = 401) in this study, 92% (n=369) reported that they had a partner present and actively involved in their lives, compared to 8% (n=32) of the national mothers who reported that they did not have a partner present in their lives. The data in this thesis thus present the findings of 369 national mothers' partners, while all the non-national mothers were reported to have a partner present in their lives (n = 49).

Significant differences were observed between the national and non-national populations as regards health insurance status during pregnancy ($p = 0.01$), fathers' education level ($p = 0.005$) and social class ($p = 0.004$), mothers' social class ($p = 0.003$), marital status ($p = 0.042$) (see **Table 3.1**), as well as smoking ($p = 0.001$) and alcohol consumption ($p = 0.002$) behaviours during pregnancy (see **Table 3.2**). In addition, a non-significant trend ($p=0.079$) towards a higher educational attainment level to primary degree and post graduate level was observed among the non-national, compared to the national mothers.

No significant differences were observed between the national and non-national populations in terms of infant birth weight ($p = 0.625$), length ($p = 0.530$) or head circumference ($p = 0.647$) measurements (see **Table 3.3**) nor in age of infants at the 6-week ($p = 0.300$) and 6-month ($p = 0.503$) follow-up time points (see **Table 3.4**). It is noteworthy that there are complete data for all birth weights in the total sample (n = 450), however, there are 16 (4%) and 3 (6%) missing birth length values in the national and non-national samples respectively, and 14 and 3 missing birth head circumference values in the national and non-national samples, respectively.

3.3 Comparison of the characteristics of the non-responders (n = 48) and responders (n = 450)

Recruitment of all expectant mothers in this study (n = 609) resulted in a non-respondent rate of 8% (n = 48). As a component of the methodology in the present study, data were collected on the non-responders (see **Section 2.4.4**). In agreement with previous research (Shepard *et al.,* 1998), the non-responders were significantly ($p = 0.000$) younger (25 yrs ± 6.7 yrs) than the responders (29.22 ± 5.7yrs) and were significantly ($p = 0.000$) more likely to have smoked during pregnancy (52%) compared to the responders (20.8%) (see **Table 3.5**). In particular, the vast majority of non-responders ante natally intended to formula feed their infants post partum (70.8%) relative to the proportion of responders who intended to formula feed (40.6%) ($p = 0.000$). No significant differences in nationality were observed between the two populations ($p=0.596$).

3.4 Comparison of the characteristics of the excluded cases and those in the total population of Mothers (n = 450), for whom full data were available

The recruitment details and reasons for case exclusions are described in **Section 2.5.2.** As shown in **Table 3.6**, no significant differences were observed between the socio-demographic or infant feeding characteristics of mothers in the total population (n = 450) and those who bore premature infants (n = 19). In total, 12 mothers were excluded due to unsuccessful follow-up at 6-weeks (n = 2) and 6-months (n = 10). Of relevance, results highlight (see **Table 3.7**) that the majority of mothers lost to follow-up were significantly more likely ($p = 0.000$) to be non-nationals (66.6%) in comparison with the total population of mothers (10.8%). In line with previous epidemiological research, follow-up of non-national subjects can be a challenge for investigators (Painter *et al.,* 2005). It has been suggested that difficulties in study participation and follow-up of non-nationals may be due to language or literacy difficulties, or national registration issues related to the duration of residence in a country (Shah *et al.*, 1996).

Similarly, mothers who were excluded owing to missing maternal reported BMI values were also significantly ($p = 0.000$) more likely to be non-nationals (66.6%) compared to the total population of mothers (10.8%) (see **Table 3.8**). Although the sample size of these excluded cases was small (n = 6), significant differences were observed ($p = 0.004$) in that no mother in this sample ante natally reported an intention to formula feed post partum, compared to 40.6% of mothers who ante natally intended to formula feed in the total population (n = 450).

Table 3.1. Comparison of the maternal and paternal social and demographic characteristics of the National and Non-National populations
(see footnote for abbreviations)

Social and demographic characteristic	National Mothers % (n)	Non-National Mothers % (n)	Significance *p value*
Mothers' pre-pregnancy BMI ($kg/m^2 \pm SD$)	24.1 ± 4.12 (n = 401)	24.56 ± 5.26 (n = 49)	**0.477**
Gestational week of mothers at time of recruitment (wks ± SD)	35.18 ± 4.26 (range 24-42 wks)	34.95 ± 4.26 (range 26-40 wks)	**0.727**
Mothers' age (mean age yrs ± SD)	29.10 ± 5.8 (n = 401)	30.18 ± 5.4 (n = 49)	**0.217**
Health insurance status			
Public	48.6 (195)	71.4 (35)	
Semi-private	37.2 (149)	22.4 (11)	
Private	14.2 (57)	6.1 (3)	**0.010***
Mothers' education level			
Primary & secondary level	39.9 (160)	34.7 (17)	
Vocational/training course	28.7 (115)	18.4 (9)	
^Primary degree	20.2 (81)	24.5 (12)	
^Post-graduate level	11.2 (45)	22.4 (11)	**0.079**
Fathers' education level			
Primary & secondary level	39.8 (147)	28.6 (14)	
Vocational/training course	31.2 (115)	18.4 (9)	
^Primary degree	19.5 (72)	30.6 (15)	
^Post-graduate level	9.5 (35)	22.4 (11)	**0.005***
Maternal social class†			
Social class 1	30.9 (124)	32.7 (16)	
Social class 2	30.7 (123)	10.2 (5)	
Social class 3	11.5 (46)	6.1 (3)	
Unknown category (unemployed/students)	11.5 (46)	22.4 (11)	
Stay at home mothers/Home-makers	15.5 (62)	28.6 (14)	**0.003***
Paternal social class †			
Social class 1	36 (133)	40.8 (20)	
Social class 2	8.4 (31)	4.1 (2)	
Social class 3	50.1 (185)	36.7 (18)	
Unknown category (unemployed/students)	5.4 (20)	18.4 (9)	**0.004***
Employment status of mothers			
Returned to work ≤ 18 wks post birth	19.7 (79)	10.2 (5)	
Returned to work > 18 wks post birth	18.2 (73)	10.2 (5)	
Did not return to work outside the home during the first 6-months post-birth	62.1 (249)	79.6 (39)	**0.055**

† Social class was based on occupation, see **Section 2.9** *significant, *p*<0.05

	National Mothers	Non-National Mothers	Significance
	% (n)	**% (n)**	***p value***
Marital status			
Married	58.6 (235)	75.5 (37)	**0.042***
Unmarried/partnered	30.9 (124)	22.4 (11)	
Single	10.5 (42)	2 (1)	
Parity			**0.084**
Primi-parous	48.9 (196)	34.7 (17)	
Multi-parous	51.1 (205)	65.3 (32)	

Figures are number of subjects in each category, mean ± standard deviation *significant, *p*<0.05

^ Third level degree and post graduate level are combined into one category in **Chapters 4** to **7** i.e. 'third level degree/post graduate level'
BMI denotes 'Body Mass Index'
kg denotes 'kilograms'
m^2 denotes 'meter squared'
SD denotes 'Standard Deviation'
wks denotes 'weeks'
yrs denotes 'years'

Table 3.2. Comparison of the maternal health behavioural characteristics of National and Non-National Mothers

Maternal health behavioural characteristic	National Mothers	Non-National Mothers	Significance
	% (n)	**% (n)**	***p value***
Smoking status during pregnancy			
Did not smoke during pregnancy	76.8 (308)	98 (48)	
Smoked during pregnancy	23.2 (93)	2 (1)	**0.001***
Alcohol consumption during pregnancy			
Alcohol consumed during pregnancy	37.9 (152)	14.3 (7)	
Did not consume alcohol during pregnancy	62.1 (249)	85.7 (42)	**0.002***
Folic acid supplementation			
Never took folic acid supplements	11.5 (46)	18.4 (9)	
Took folic acid post-conception	47.4 (190)	49 (24)	

Took folic acid pre- and post conception	41.1 (165)	32.7 (16)	**0.286**

*significant, $p<0.05$

Table 3.3. Comparison of the birth-related characteristics of the infants born to National and Non-National Mothers

Infant characteristic	**National Mothers % (n)**	**Non-National Mothers % (n)**	**Significance** ***p value***
Gestational age at birth (mean wks ± SD)	40.21 ± 1.3 (n = 401)	39.86 ± 1.14 (n = 49)	**0.077**
Type of delivery			
Spontaneous vaginal delivery	76.6 (307)	75.5 (37)	
Caesarean section	23.4 (94)	24.5 (12)	**1.000**
Birth weight (kg ± SD)	3.55 ± 0.52 (n=401)	3.59 ± 0.54 (n=49)	**0.625**
Birth length (cm ± SD)	51.28 ± 2.46 *	51.53 ± 2.8 †	**0.530**
Birth head circumference (cm ± SD)	35.18 ± 1.47 **	35.07 ±1.39 †	**0.647**
6-week weight (kg ± SD)	4.96 ± 0.63 (n=234)	5.18 ± 0.63 (n=26)	**0.092**
6-week length (cm ± SD)	56.89 ± 2.63 (n=216)	57.69± 2.34 (n=22)	**0.172**
6-month weight (kg ± SD)	8.02 ± 0.94 (n=97)	8.44 ± 0.91 (n=11)	**0.161**
6-month length (cm ± SD)	67.83 ± 2.52 (n=97)	68.9± 3.23 (n=11)	**0.195**

Figures are number of subjects in each category, mean ± standard deviation.
* 16 missing values ** 14 missing values † 3 missing values
wks denotes 'weeks' SD denotes 'Standard Deviation'
kg denotes 'kilograms' cm denotes 'centimetre'

Table 3.4. Age of infants at 6-week and 6-month follow-up

Age of infants	**National mother-infant pairs**	**Non-National mother-infant pairs**	**Significance** ***p value***
6-week follow-up (wk ± SD)	6.57 ± 0.42 (range 6-8 wks)	6.51 ± 0.4 (range 6-7.42 wks)	**0.300**
6-month follow-up (wk ± SD)	24.73 ± 0.43 (range 24-26 wks)	24.68 ± 0.42 (range 24-25.7 wks)	**0.503**

wks denotes 'weeks' SD denotes 'Standard Deviation'

Table 3.5. Comparison of the characteristics of the responder (n = 450) and non-responder (n = 48) populations

Characteristic	**Responders**	**Non-responders**	**Significance**
	% of mothers (n)	**% of mothers (n)**	***p value***
Mothers' age (yrs ± SD)	29.22 ± 5.7 (n = 450)	25.0 ± 6.7 (n = 48)	**0.000****
Ante natal infant feeding intention			
Breastfeeding	42.2 (190)	25 (12)	
Formula feeding	40.6 (183)	70.8 (34)	
Partial breastfeeding	9.1 (41)	0 (0)	
Undecided	8 (36)	4.1 (2)	**0.000****
Nationality			
National mothers	89.1 (401)	85.4 (41)	
Non-national mothers	10.8 (49)	14.5 (7)	**0.596**
Smoking status during pregnancy			
Did not smoke during pregnancy	79.1 (356)	47.9 (23)	
Smoked during pregnancy	20.8 (94)	52 (25)	**0.000****

yrs denotes 'years'
SD denotes 'Standard Deviation'
**significant, $p<0.001$

Table 3.6. Comparison of the socio-demographic and infant feeding characteristics of the Mothers who bore premature infants (n = 19) and those of the total population of Mothers for whom full data were available (n = 450)

Characteristic	**Total population**		**Mothers who bore premature infants**		**Significance**
	% of mothers	**(n)**	**% of mothers**	**(n)**	***p value***
Mothers' age					
(yrs ± SD)	29.22 ± 5.7	(n = 450)	29.89 ± 6.8	(n = 19)	**0.622**
Mothers' education level					
Primary & secondary level	39.3	(177)	47.3	(9)	
Vocational/training course	27.5	(124)	26.3	(5)	
^Primary degree	20.6	(93)	5.2	(1)	
^Post-graduate level	12.4	(56)	21	(4)	**0.318**
Parity					
Primi-parous	47.3	(213)	36.8	(7)	
Multi-parous	52.6	(237)	63.1	(12)	**0.507**
Smoking status during pregnancy					
Did not smoke during pregnancy	79.1	(356)	63.1	(12)	
Smoked during pregnancy	20.8	(94)	36.8	(7)	**0.170**
Nationality					
National mothers	89.1	(401)	100	(19)	
Non-national mothers	10.8	(49)	0		**0.255**
Ante-natal infant feeding					
intention	42.2	(190)	36.8	(7)	
Breastfeeding	40.6	(183)	52.6	(10)	
Formula feeding	9.1	(41)	0		
Partial breastfeeding	8	(36)	10.5	(2)	**0.451**
Undecided					
Breastfeeding initiation					
Initiated breastfeeding	50.6	(228)	52.6	(10)	
Did not initiate breastfeeding	49.3	(222)	47.3	(9)	**1.000**

^ Third level degree and post graduate level are combined into one category in **Chapters 4** to **7** i.e. 'third level degree/post graduate level'

yrs denotes 'years'
SD denotes 'Standard Deviation'

Table 3.7. Comparison of the socio-demographic and infant feeding characteristics of the Mothers who were unsuccessfully followed up at 6-weeks (n = 2) and 6-months (n = 10) and those of the total population of Mothers for whom full data were available (n = 450)

Characteristic	Total population		'Lost to follow-up' at 6-wks & 6-mths'		Significance
	% of mothers	(n)	% of mothers	(n)	*p value*
Mothers' age (yrs ± SD)	29.22 ± 5.7 (n = 450)		28 ± 5.08 (n = 12)		**0.470**
Mothers' education level					
Primary & secondary level	39.3	(177)	50	(6)	
Vocational/training course	27.5	(124)	33.3	(4)	
^Primary degree	20.6	(93)	8.3	(1)	
^Post-graduate level	12.4	(56)	8.3	(1)	**0.680**
Parity					
Primi-parous	47.3	(213)	33.3	(4)	
Multi-parous	52.6	(237)	66.6	(8)	**0.505**
Smoking status during pregnancy					
Did not smoke during pregnancy	79.1	(356)	83.3	(10)	
Smoked during pregnancy	20.8	(94)	16.6	(2)	**1.000**
Nationality					
National mothers	89.1	(401)	33.3	(4)	
Non-national mothers	10.8	(49)	66.6	(8)	**0.000****
Ante-natal infant feeding intention					
Breastfeeding	42.2	(190)	41.6	(5)	
Formula feeding	40.6	(183)	25	(3)	
Partial breastfeeding	9.1	(41)	25	(3)	
Undecided	8	(36)	8.3	(1)	**0.282**
Breastfeeding initiation					
Initiated breastfeeding	50.6	(228)	80	(8)*	
Did not initiate breastfeeding	49.3	(222)	20	(2)*	**0.130**

* 2 missing cases due to unsuccessful follow-up at 6-weeks **significant, $p<0.001$

^ Third level degree and post graduate level are combined into one category in **Chapters 4** to **7** i.e. 'third level degree/post graduate level'

yrs denotes 'years'
SD denotes 'Standard Deviation'

Table 3.8. Comparison of the socio-demographic and infant feeding characteristics of the Mothers who were excluded due to missing BMI values (n = 6), and those of the total population of Mothers for whom full data were available (n = 450)

Characteristic	Total population % of mothers	(n)	Excluded cases due to missing BMI values % of mothers	(n)	Significance *p value*
Mothers' age (yrs ± SD)	29.22 ± 5.7 (n = 450)		31.66 ± 3.3 (n = 6)		**0.303**
Mothers' education level					
Primary & secondary	39.3	(177)	66.6	(4)	
Vocational/training course	27.5	(124)	16.6	(1)	
Primary degree	20.6	(93)	16.6	(1)	
Post-graduate level	12.4	(56)	0		**0.539**
Parity					
Primi-parous	47.3	(213)	0		
Multi-parous	52.6	(237)	100	(6)	**0.058**
Smoking status during pregnancy					
Did not smoke during pregnancy	79.1	(356)	100	(6)	
Smoked during pregnancy	20.8	(94)	0		**0.454**
Nationality					
National mothers	89.1	(401)	33.3	(2)	
Non-national mothers	10.8	(49)	66.6	(4)	**0.000****
Ante-natal infant feeding intention					
Breastfeeding	42.2	(190)	33.3	(2)	
Formula feeding	40.6	(183)	0		
Partial breastfeeding	9.1	(41)	50	(3)	
Undecided	8	(36)	16.6	(1)	**0.004***
Breastfeeding initiation					
Initiated breastfeeding	50.6	(228)	66.6	(4)	
Did not initiate breastfeeding	49.3	(222)	33.3	(2)	**0.713**

yrs denotes 'years' SD denotes 'Standard Deviation' *significant p<0.05, ** p<0.001

3.5 Conclusion

This chapter describes and compares the characteristics of mothers in the two main study populations, notably the national and non-national sample, to whom **Chapter 4** will relate. The differences in socio-demographic characteristics observed between the two populations will be discussed in terms of the degree to which these cultural specific influences may impact on mothers' feeding practices post partum. The fact that there were no significant differences between the national and non-national mothers in terms of birth anthropometric measurements, nor between the ages of infants at the 6-week and 6-month follow-up times, allows a clearer interpretation of the data and precludes any confounding that may be implicated if these variables differed.

Knowledge of the characteristics of the non-responders and those who were excluded from the analysis provides insight into the differences between these populations, relative to the respondent population (n = 450) that met the study inclusion criteria. An awareness that the responder and non-responder populations differed significantly with a higher preponderance observed towards negative health behaviours among the non-responders in this study, suggests the importance of collecting data on the non-responders in future infant feeding research. It is also relevant that the non-responder, compared to the responder population was significantly more likely to have ante natally intended to formula feed ($p = 0.000$) in the present study.

In Ireland, owing to the recent increase in immigrants, infant feeding studies that have included non-nationals are few. Since this group comprise of 10% of our current population (CSO, 2006), the inclusion of non-nationals in Irish research is essential. Although the vast majority of mothers were successfully followed up at 6-weeks (98.5%) and 6-months (95%) in this study, the mothers who were lost to follow-up were significantly more likely to be non-nationals. While it has been acknowledged that difficulties in the recruitment and follow-up of non-nationals may have serious negative consequences for the quality and continuity of the health care provided to them (Shah *et al.*, 1996), our results indicate that more persistent efforts or the provision of incentives may be required to follow up non-nationals in longitudinal studies.

Chapter 4

Breastfeeding Initiation, Prevalence and Duration Rates among National and Non-National Mothers

CHAPTER INDEX **PAGE**

4.1. Introduction

Irish breastfeeding initiation and duration rates are among the lowest in the world (Freeman, 1996) highlighting the need for increased commitment to documenting breastfeeding practices using standardised definitions. As far back as the 1970's public health investigators expressed concern that formula feeding had become an accepted feature of life in Ireland. During the subsequent decades, reports indicate that little has changed. Regional research indicates a considerable decline in breastfeeding rates between discharge from the maternity hospital and 4 to 6 weeks post partum (see **Table 1.2**) Documentation of the initiation rate is important, however, the duration and exclusivity for which breastfeeding is maintained is fundamental in determining the potential benefits for the infant.

A number of limitations exist as regards the collection of breastfeeding data both in national breastfeeding monitoring and in existing regional Irish studies. The FSAI (1999) acknowledged that limited information is available about the feeding of Irish infants and although breastfeeding rates have been recorded in regional studies, samples were either volunteers or biased towards mothers of higher socio-economic status. Moreover, the National Perinatal Statistics represent breastfeeding rates 'upon discharge from the maternity hospital' and do not record the initiation rate post birth, making comparison with international breastfeeding initiation rates difficult. A comprehensive and prospective national monitoring system has not yet been implemented in Ireland. Furthermore, no data exist on the breastfeeding rates of non-national mothers living in Ireland, presenting a need to report on their breastfeeding practices.

Above all, precise and consistent use of standardised breastfeeding definitions and indicators is paramount in infant feeding research (Yngve & Sjostrom, 2001a) enabling unambiguous calculation and observation of breastfeeding trends over time (Aarts *et al.*, 2000). Moreover, in an effort to increase the availability of comparable data, the WHO/UNICEF (2003c) recommended that internationally agreed indicators and data collection strategies should be considered at local and national level.

4.2 Aims and objectives

This study was designed to provide and examine figures on breastfeeding initiation, prevalence and duration rates from birth to 6-months post partum in a sample of national and non-national mothers in Dublin. The specific objectives were to:

- ✓ Report the breastfeeding initiation rates of national and non-national mothers
- ✓ Report and compare the prevalence of ‘exclusive’, ‘predominant’, ‘partial’ and ‘any’ breastfeeding at hospital discharge, at 4, 6, 8, 12, 16 and 20 weeks and at 6 months post partum between national and non-national mothers
- ✓ Document and compare the duration (no. of days) of ‘exclusive’ and ‘any’ breastfeeding between national and non-national mothers during the first 6-months

4.3 Methodology

The study design, development of questionnaires, sample selection, recruitment, and the inclusion and exclusion criteria for the 6-week and 6-month follow-up of all mothers are given in **Chapter 2.** Comparisons of the baseline socio-demographic, infant and maternal health behavioural characteristics between the national and non-national mothers are described in **Chapter 3**.

4.3.1 Breastfeeding definitions used in the present study

The definitions of exclusive and predominant breastfeeding in the present study were in accordance with the WHO (1991) and (1996) breastfeeding definitions outlined in **Table 1.1**. The **‘**partial breastfeeding’ category included infants who received breast milk in combination with formula feeds or other non-human milk feeds and/or solid food. ‘Any’ breastfeeding refers to all infants who received any breast milk or a combination of breast milk with other non-human milk feeds and/or solid food.

Breastfeeding ‘initiation’ refers to all mothers who ‘ever’ tried to breastfeed post birth, including mothers who put their infants to the breast with the intention to breastfeed.

Breastfeeding ‘duration’ denotes the number of days during the first six months for which exclusive or ‘any’ breastfeeding continued during the study time frame.

Study **‘time points’** includes specific study intervals at which data on infant feeding status were recorded including initiation post birth, hospital discharge, 4, 6, 8, 12, 16 and 20 weeks as well as at 6-months.

4.3.2 The collection of breastfeeding data

Breastfeeding data were collected *via* use of standardised questionnaires at 6-weeks (see **Appendix IX**) and 6-months (see **Appendix X**) based on maternal reporting of the infants ‘current feeding status’, with a further 24-hour recall of the infants usual diet at 6-months. At the 6-week interview, the infant feeding status was retrospectively recorded including ‘feeding status at hospital discharge’ and 4-weeks post partum. Similarly, the feeding status was retrospectively recorded from the 6-month interview enabling the documentation of breastfeeding prevalence rates and feeding status at 8, 12, 16 and 20 weeks. It was always clarified with mothers whether they were only providing breast milk to their infants or including other supplementary fluids or solid foods in the feeding regime. Following interviews with mothers, the investigator repeated the recorded feeding pattern and practices back to mothers and confirmed the accuracy of the data.

In addition, data on specific feeding practices were broadly categorized at each time point then subsequently re-coded and collapsed into the definitions outlined in **Section 4.3.1**. For instance 'breastfeeding and solid food', 'breastfeeding with solids and formula feeds' and 'breastfeeding with formula milk' were recorded in separate categories at each of the study time points, and then subsequently collapsed into the 'partial breastfeeding' category for further analysis.

For mothers who initiated breastfeeding but who were no longer breastfeeding at 6-weeks or 6-months, data were collected on number of days mothers exclusively, predominantly or partially breastfed, from which the duration of 'any' breastfeeding was calculated and recorded. In questions relating to duration time and age, it was explained that one month was denoted as 4 weeks, thus 4 months was equated to 16 weeks.

4.3.3 National and Non-National Mothers who delivered in the Coombe Women's Hospital, Dublin

In the present study, 'national mothers' refers to all mothers born in the Republic of Ireland, thus having Irish citizenship. Mothers who were born outside the Republic of Ireland were characterised as being 'non-national mothers'. For convenience, the infants born to non-national mothers were referred to as 'infants of non-national mothers'. All mothers were recruited from the Coombe Women's Hospital, which has membership to the Breastfeeding Friendly Hospital Initiative (BFHI). During the study time frame (2004-2006) one lactation consultant was employed (1 whole time equivalent post) in the hospital.

4.3.4 Statistical analysis

SPSS Version 13.0 (SPSS, Chicago, IL, USA) was used for all statistical analyses. Data are presented using numerical descriptive statistics including means with standard deviations and medians with interquartile ranges. Breastfeeding rates were collected from all mothers and are presented using percentages and actual (n) values. The relationship between categorical variables was examined using cross tabulations of the Chi-Squared test. For cross-tabulations involving two dichotomous variables, the Yates's continuity correction value was used. When comparing the mean values for continuous variables between national and non-national mothers, the data were initially assessed for normality of distribution and the Independent Samples *t-test* (normally-distributed data) and the Mann-Whitney *U* Test (skewed data) used as appropriate. A *P*-value less than 0.05 was considered statistically significant.

4.4 Results

4.4.1 Breastfeeding initiation rates

In total, 47.1% (n = 189) national and 79.6% (n = 39) non-national mothers initiated breastfeeding post birth.

4.4.2 Breastfeeding prevalence rates

Direct comparison of the breastfeeding rates between the national (n = 401) and non-nationals (n = 49) indicates significantly higher breastfeeding initiation (*p=0.000*) and prevalence (*p=0.000*) rates (exclusive, predominant, partial and any breastfeeding) among non-national mothers during the first 20-weeks post partum (see **Figures 4.1** to **4.4**). The exclusive, predominant, partial and any breastfeeding rates (with n values) of the national (n = 49) and non-national (n = 401) mothers, for which complete infant feeding data are available, are presented in **Appendix XI.**

No significant differences were observed between the two populations in terms of the ages of the national and infants of non-national mothers at the 6-week (6.57wks ± SD 0.42 and 6.51wks ± SD 0.4 respectively) (*p=0.300*) and 6-month (24.73wks ± SD 0.43 and 24.68wks ± SD 0.42 respectively) (*p=0.503*) follow-up times (see **Table 3.4**).

Figure 4.1. Prevalence of 'any' breastfeeding from birth to six months among National (n=401) and Non-National (n=49) Mothers

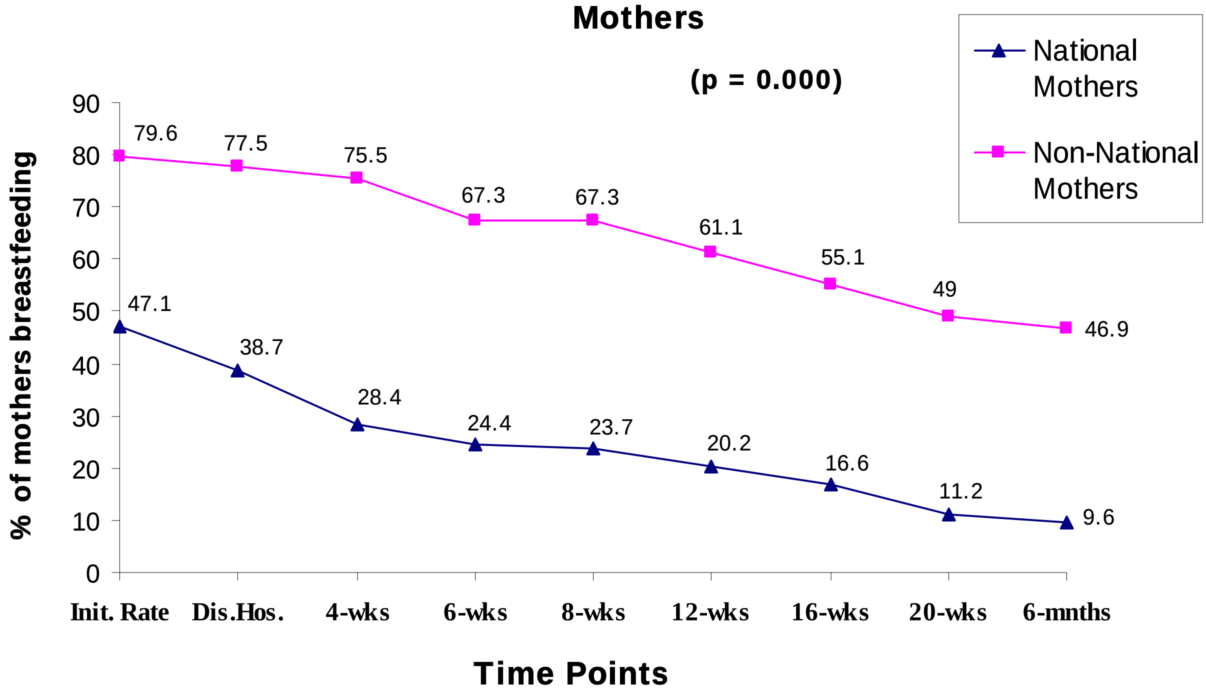
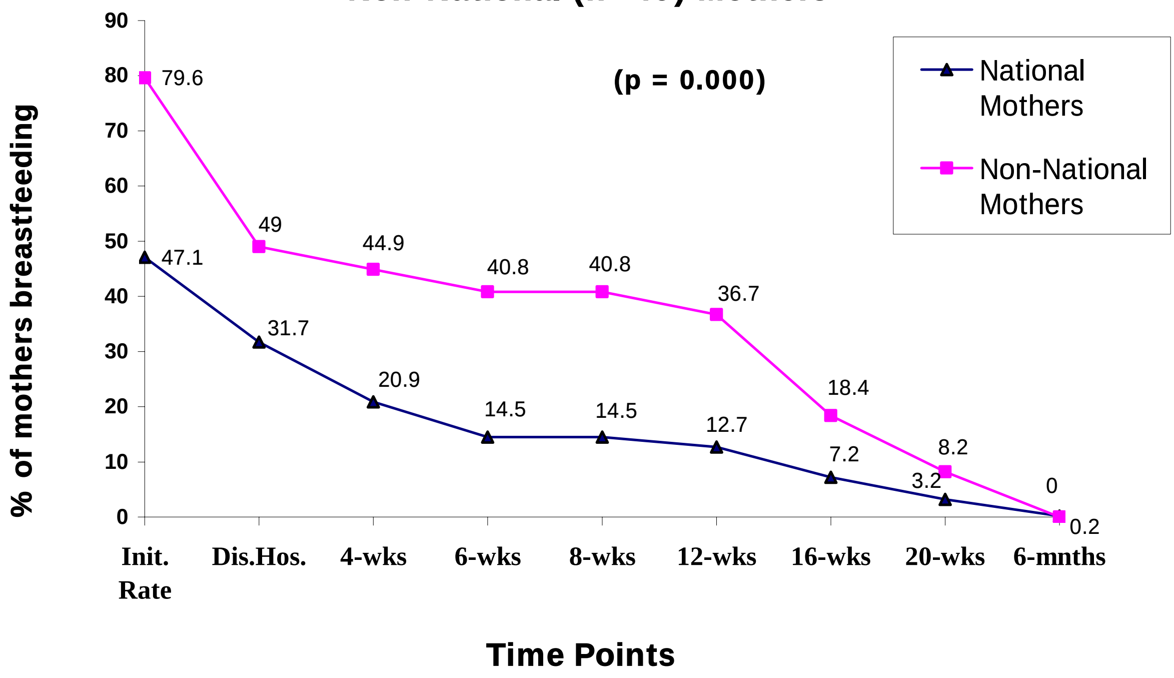


Figure 4.2. Prevalence of Exclusive Breastfeeding from birth to six months among National (n=401) and Non-National (n=49) Mothers



Init. Rate denotes 'initiation rate'
Dis.Hos. denotes 'hospital discharge'
wks denotes 'weeks'
mnths denotes 'months'

Figure 4.3. Prevalence of 'partial' breastfeeding from hospital discharge to six months among National (n=401) and Non-National (n=49) Mothers

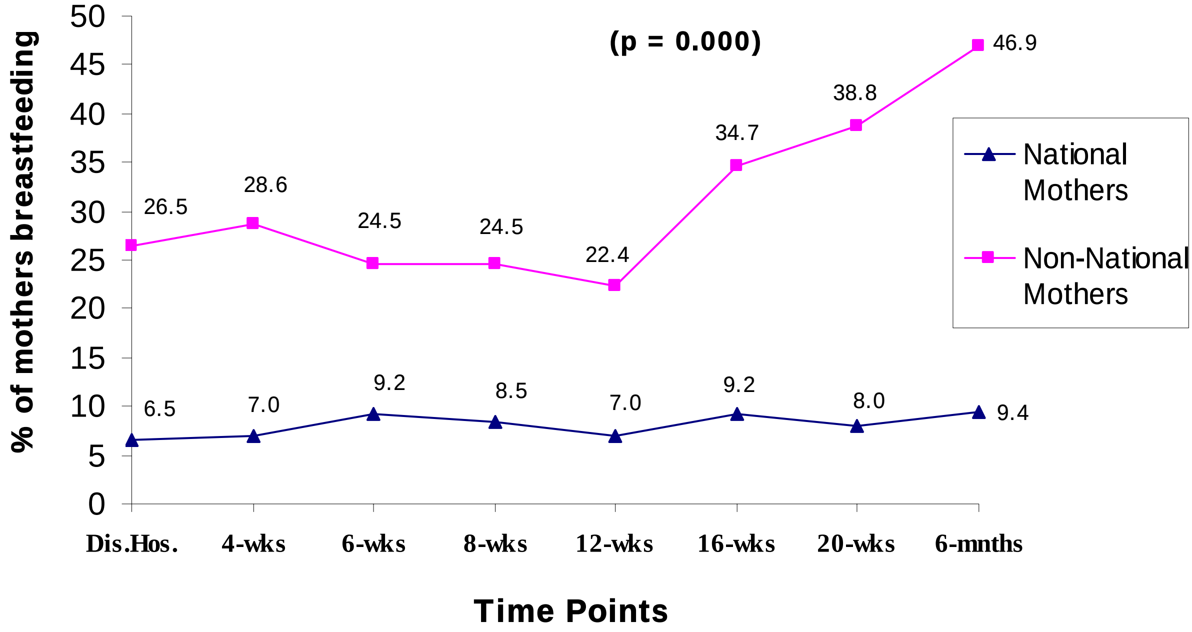
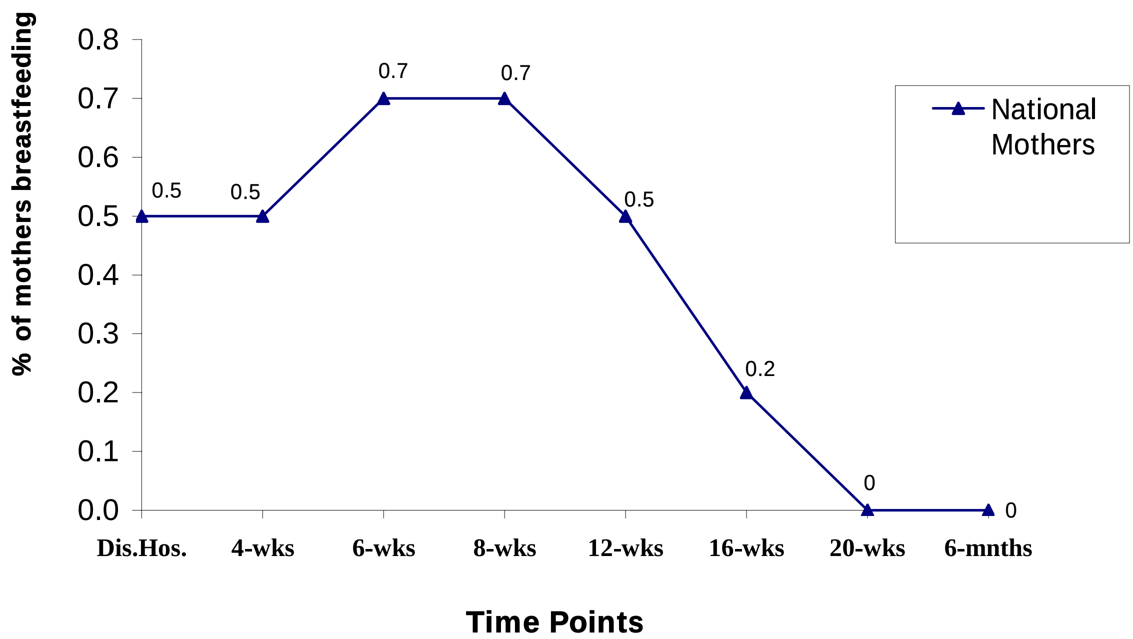


Figure 4.4. Prevalence of Predominant Breastfeeding from hospital discharge to 6-months among National Mothers (n = 401)



Dis.Hos. denotes 'hospital discharge'
wks denotes 'weeks'
mnths denotes 'months'

'Any' breastfeeding rates

A greater proportion of national mothers discontinued breastfeeding (8.4% drop in any breastfeeding rate) from initiation to the time of hospital discharge compared to only 2% of non-national mothers. Of major significance, the highest drop off in 'any' breastfeeding rates throughout the study was observed between hospital discharge and 4-weeks among national mothers (10.3% drop off in 'any' breastfeeding rate) and between 4 to 6 weeks among non-national mothers (8.2% drop off in 'any' breastfeeding rate). In addition, results indicate that non-national mothers were significantly ($p=0.05$) more likely to have been discharged from the maternity hospital earlier (3.26 days ± SD 1.63) than the national mothers (3.78 days ± SD 1.75). As illustrated in **Figure 4.1**, significantly ($p=0.000$) higher 'any' breastfeeding rates among non-nationals continued throughout the first 6-months indicated by the fact that almost two thirds (61.1%) of non-national mothers were still offering any breast milk to their infants at 12-weeks and just under half of this population (46.9%) were still offering any breast milk at 6-months. In contrast, the 'any' breastfeeding rate among national mothers was comparatively lower at 12-weeks (20.2%) and at 6-months (9.6%) post partum.

Exclusive breastfeeding rates

Following a similar trend, higher exclusive breastfeeding rates were observed among the non-national compared to the national mothers during the first 20-weeks (see **Figure 4.2**). However relative to current infant feeding recommendations, the exclusive breastfeeding rates in the non-national and national populations were markedly low at hospital discharge (49% and 31.7% respectively) and at every time point in the study.

Of the non-national and national mothers who initiated breastfeeding (79.6% and 47.1% respectively), approximately two thirds in both populations (61% and 67%

respectively) were exclusively breastfeeding at hospital discharge. Of the non-national mothers who were exclusively breastfeeding at hospital discharge (49%), 40.8% of these mothers maintained exclusive breastfeeding between 6 and 8 weeks. However, a gradual decline in exclusive breastfeeding was observed in the non-national population between 8 and 12 weeks (40.8% to 36.7%) with rates rapidly dropping to 18.4% by 16 weeks. Coinciding with the prominent drop (18.3%) in exclusive breastfeeding between 12 to 16 weeks among non-national mothers, the partial breastfeeding rate increased from 22.4% to 34.7% during this study interval (see **Figure 4.3**). Similarly, poor maintenance of exclusive breastfeeding was observed among national mothers with a rapid decrease in exclusive rates observed from hospital discharge (31.7%) to 20.9% at 4-weeks and 14.5% at 6 and 8 weeks. Less than half (44%) of the national mothers who initiated breastfeeding were exclusively breastfeeding at 4-weeks post partum. Identical proportions of national and non-national mothers maintained exclusive breastfeeding between 6 and 8 weeks, by 14.5% and 40.8% of mothers respectively. From the two populations, only one national mother was still exclusively breastfeeding at 6-months.

Partial breastfeeding rates

The partial breastfeeding rate at hospital discharge was comparatively higher in non-national (26.5%) than national mothers (6.5%) ($p=0.000$) and these rates were relatively well sustained to 12-weeks in both populations (see **Figure 4.3**). In particular, a marked increased trend towards partial breastfeeding was evident at 16-weeks, 20-weeks and at 6-months among non-national mothers. Non-national, compared to national mothers were thus more likely to introduce formula milk to the breastfeeding regimen during the maternity hospital stay and continued to partially breastfeed during the first 6-months. A comparatively lower but sustained partial breastfeeding rate was observed among the national population with 6.5% of national mothers partially breastfeeding at hospital discharge, 7% at 12-weeks and 9.4% at 6-months.

Further analysis of the partial breastfeeding category in the national and non-national populations at 12-weeks[¥] and 16-weeks[∝] suggests a particular tendency among non-national mothers to introduce solid foods into their infant's diet during this study interval. Specifically, the proportion of infants in the non-national population consuming breast with formula milk decreased from 20.4% at 12 weeks to 10.2% at 16-weeks with a subsequent increase in the proportion of these infants consuming a mixed diet of solid foods and breast milk (8.2%) and solids with breast and formula milk (16.3%).

Predominant breastfeeding rates

Relative to the exclusive and partial breastfeeding rates in the national and non-national populations, the predominant breastfeeding rate in both populations remained low during the first 6-months. From hospital discharge through to 20 weeks post partum, the predominant breastfeeding rate among non-national mothers was maintained at 2% (n=1) (see **Appendix XI**), while less than 1% of national mothers maintained the practice during the first 16-weeks (see **Figure 4.4**).

[¥] Partial breastfeeding at 12-weeks in the national population: 6.2% breast & formula milk; 0.4% breast milk & solid foods; 0.2% breast with formula milk & solid foods. In the non-national population: 20.4% breast & formula milk; 0% breast milk & solid foods; 2% breast with formula milk & solid foods

[∝] Partial breastfeeding at 16-weeks in the national population: 3.5% breast & formula milk; 3% breast milk & solid foods; 2.7% breast with formula milk & solid foods. In the non-national population: 10.2% breast & formula milk; 8.2% breast milk & solid foods; 16.3% breast with formula milk & solid foods

4.4.3 Breastfeeding duration rates

As highlighted in **Figure 4.5**, the duration of ‘any’ breastfeeding during the study time frame, presented as ‘number of days’, was significantly higher in the non-national (median 170 days, n = 39) compared to the national (median 56 days, n = 189) population *($p = 0.000$)* while no significant difference was observed in the number of days mothers exclusively breastfed between the two populations (see **Figure 4.6**) *($p = 0.510$).*

Figure 4.5. Duration of 'Any' Breastfeeding from birth to 6-months in Non-National and National Mothers

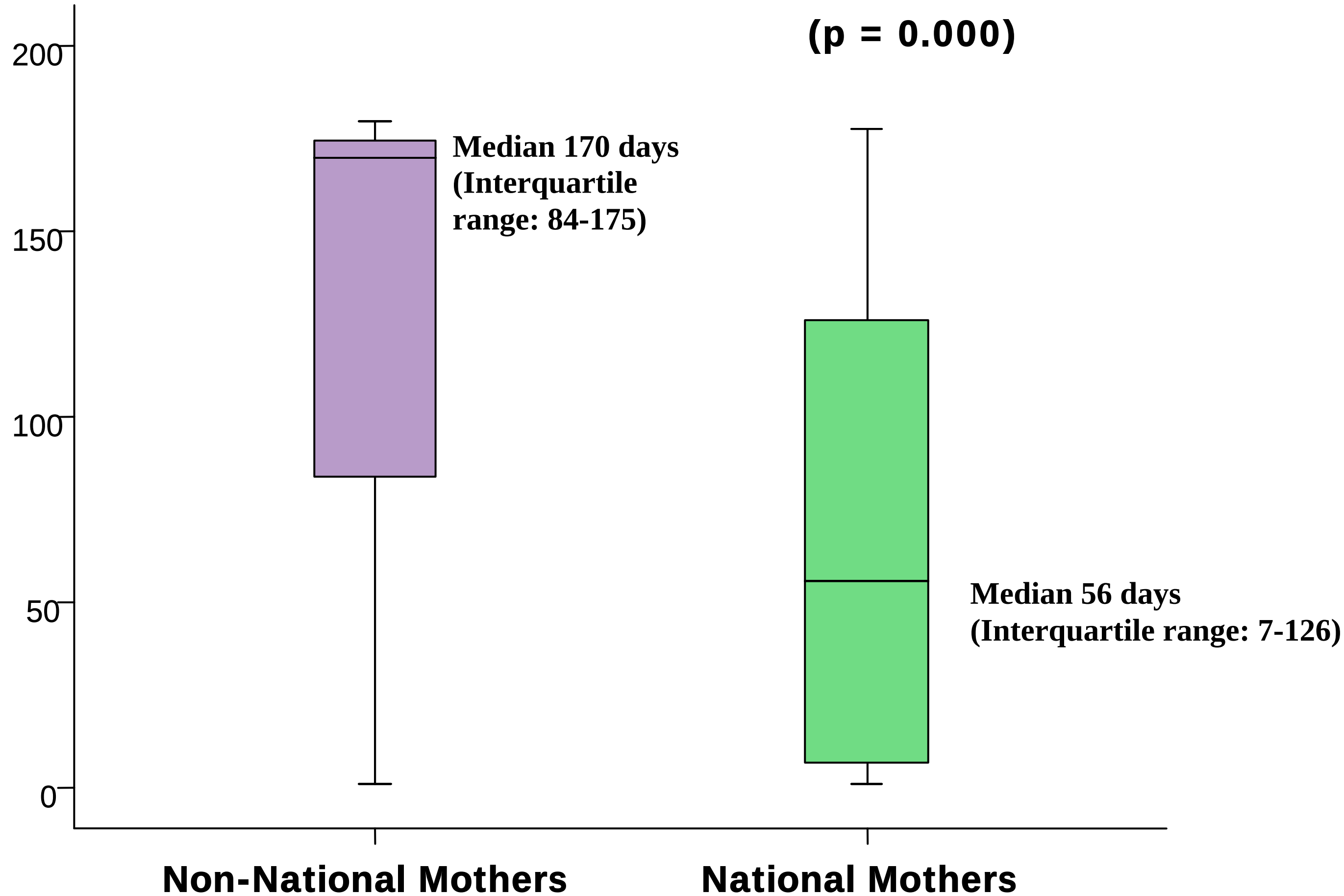
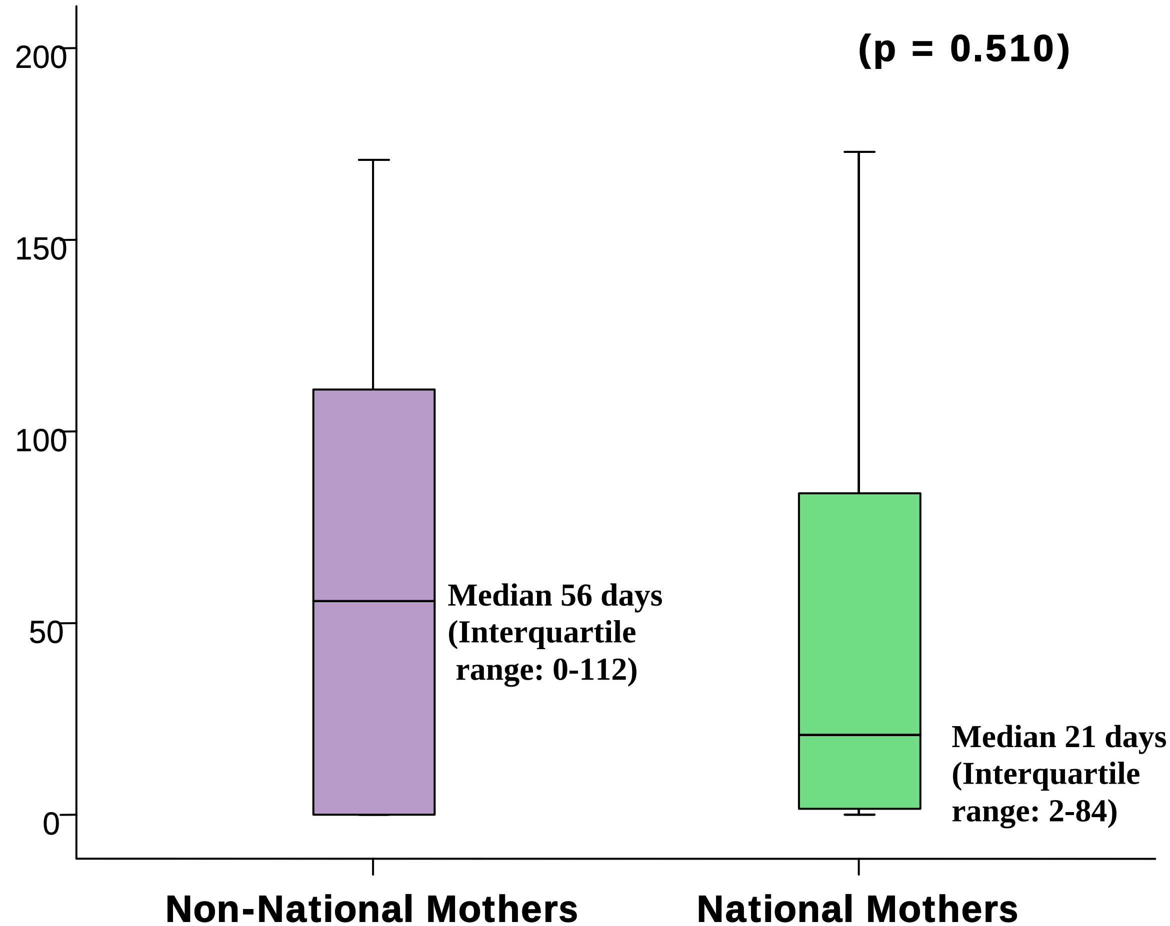


Figure 4.6. Duration of Exclusive Breastfeeding from birth to 6-months in Non-National and National Mothers



4.5 Discussion

From the initial exploration of the data, it became apparent that the national and non-national populations differed significantly, thus they were considered separately for the purpose of comparison. Using the breastfeeding definitions outlined in **Section 4.3.1,** this study found that the breastfeeding initiation rates were significantly higher among non-national (79.6%) compared to national (47.1%) mothers (*p=0.000*). Consistent with this finding, studies examining the breastfeeding rates in other ethnically diverse populations demonstrate similar trends. Work by Kelly *et al.,* (2006) in the UK (n = 17, 474) found that the highest breastfeeding rates from initiation to 3-months post partum were among the Black African, Black Caribbean and Asian, compared to white mothers, even after adjustment for socio-demographic, economic and psychosocial factors (Kelly *et al*., 2006). Other investigators in the USA have documented similar findings with foreign born Latina mothers being more likely to initiate breastfeeding than USA-born Latina, or white non-Hispanic mothers (Heck *et al.,* 2006). It is well established that culturally based feeding beliefs influence how mothers make decisions (Itina, 1997), however, the context of maternal beliefs and decisions can also change in those who immigrate to a different culture and geographic region (Kannan *et al.,* 1999). For instance, Goel *et al.,* (1978) highlighted concern over the lack of breastfeeding uptake among Chinese (n = 48/49) immigrant mothers, after arriving in Scotland.

Breastfeeding initiation

Although Irish studies focussing on the initiation of breastfeeding are few (see **Table 1.2**), regional Irish research conducted in the east of Ireland suggests that the initiation rates have increased modestly from the 1990's with lower breastfeeding initiation rates of 39.5% (Fitzpatrick *et al.,* 1994) and 38% (Sayers *et al.,* 1995) reported than those found among the national mothers in the present study. Twomey *et al.,*

(2000) and Ward *et al.*, (2004) both reported an identical higher initiation rate of 51%; however investigators in the latter study acknowledged that the over-representation of higher socio-economic groups may have explained the higher rates. Similar to the comparatively higher international initiation rates highlighted in **Table 1.3**, the majority of non-national (79.6%) mothers in the present study initiated breastfeeding. Despite concerted national efforts to promote and support breastfeeding, it appears from our data that little improvement has been achieved over the last decade in terms of breastfeeding uptake among national mothers. The potential factors that are associated with breastfeeding initiation among national mothers are described in **Chapter 5**.

Breastfeeding prevalence rates

It is of further concern that the exclusive breastfeeding rate at hospital discharge among national mothers in this study (31.7%) is almost identical to the exclusive rates reported in the 'national infant feeding' studies from 1982 (McSweeney & Keveny, 1982) and 1986 (McSweeney, 1996) of 29% and 31% respectively. Although later studies did not report the exclusive breastfeeding rate at hospital discharge, almost similar 'any' breastfeeding rates were documented in regional studies including 31.5% (Loh *et al.*, 1997), 32% (Sayers *et al.*, 1995) and 33% (Lowry & Lillis, 1993).

Moreover, the most recent Perinatal Statistics from 2004, which coincide with the first year of data collection in the present study, indicates that 42.5% of mothers in Ireland were exclusively breastfeeding at hospital discharge, which is higher than the figure found in this study among national mothers (31.7%). Taken together (n = 450), the exclusive breastfeeding rates at hospital discharge of the national (31.7%, n = 127) and non-national (49%, n = 24) populations suggest an overall exclusive breastfeeding rate of 33.5%, which is still markedly lower than the rate reported in the National Perinatal Statistics (2004). As the national and non-national populations in the present study were not nationally representative samples, it may be that the low breastfeeding initiation rates found in this study were specific to the mothers who attended the Coombe Women's Hospital located in west Dublin (2004-2006). Higher breastfeeding initiation rates of 56% in 2005 and 58% in 2006 have been reported in the Rotunda Hospital (BFHI status) located in north Dublin, while the National Maternity Hospital (BFHI Certificate of Commitment) in south Dublin reported initiation rates of 59% in 2005 and 62% in 2006. Moreover, the exclusive breastfeeding rate at hospital discharge in the Rotunda Hospital was reported as 44% in 2005 and 2006, a comparatively higher figure that that reported in the national mothers in the present study (31.7%). A future multi-sited infant feeding study in Dublin incorporating a representative sample of national and non-national mothers may prove effective in investigating possible reasons for the differences in breastfeeding rates, with the Coombe Hospital representing the 'low breastfeeding category' reference group.

As the National Perinatal Statistics do not examine breastfeeding rates by mother's nationality (national versus non-nationals), it is difficult to comment on the breastfeeding practices of the national and non-national mothers in a nationally representative context. Based on the results from present study, the extent to which the breastfeeding rates reported in the National Perinatal Statistics are influenced by the higher breastfeeding rates in the non-national population of mothers must be considered. Furthermore, the CSO (2006) reported that non-nationals account for 10% of the current Irish population, a figure that is increasing annually. The Coombe Women's Hospital 2004 Annual Report, the study site from which mothers in this study were recruited, indicated that 24% of mothers who delivered infants in the hospital were non-nationals, a higher proportion than that found in the present study. The 2004 Annual Clinic Report from the Rotunda Hospital indicated higher proportions of non-national deliveries (29%) during the same year. A separate examination of breastfeeding rates by mother's nationality may be more informative as to breastfeeding trends and practices in future

Irish infant feeding research, and indeed, in the compilation of the National Perinatal Statistics.

The results from this study also demonstrate that the national mothers who attempted to breastfeed in the maternity hospital were most likely to discontinue the practice during the hospital stay indicated by the 8.4% drop in the 'any' breastfeeding rate from initiation (47.1%) to 38.7% at hospital discharge, and between hospital discharge to 4-weeks (10.3% drop in 'any' breastfeeding). Other Irish investigators have reported similar findings (Twomey *et al.*, 2000). The fact that almost 20% of national mothers who initiated breastfeeding had abandoned the practice by 4-weeks suggests that the interval from birth to 4-weeks is particularly sensitive to a change in the feeding decision and breastfeeding cessation; however, a number of reasons may be considered for this early high decline in the 'any' breastfeeding rate. Firstly, it could be speculated that these mothers were possibly aware of the particular benefits of breastfeeding and the provision of colostrum to their infant post birth and may have planned to breastfeed for the initial few days to provide some immunity to their infants, then voluntarily discontinued prior to hospital discharge. Secondly, the intent to breastfeed may have been high and positive among these mothers, however, other determinants, that will be discussed in greater detail in **Chapter 5**, influenced discontinuation during the hospital stay or at home. Thirdly, the intent to breastfeed may have been low among some mothers in that they may have wanted to '*give breastfeeding a try*', but were happy to discontinue the practice if difficulties arose during the initial weeks. It is highly unlikely that the influence of work return had a negative impact on low prevalence rates during the first 6-weeks post birth owing to the fact that the duration of maternity leave in Ireland was 22 weeks (fully paid leave) throughout the study time frame (2004-2006). Previous regional research has pointed towards mothers' perception of the insufficiency of her breast milk supply as a major reason for discontinuation during the first week

(Ward, 1996) and at 3-months (O'Herlihy, 1978). Cessation during the first 6-weeks has been associated with mother's perception of increased infant 'hunger' (Sayers *et al.,* 1995; Ward *et al.,* 2004) as well as maternal concern that the infant was 'not getting enough breast milk' (Lowry & Lillis, 1993; Fennessy, 1999). Maternal tiredness (18.5%), breast problems (18.5%), mothers' perception that the infant was unsettled on breast milk (15%) and that the milk supply was insufficient to meet the infants' requirements (18.5%) have also been reported as reasons for terminating breastfeeding during the first 6-weeks (Howell *et al.,* 1996). Nonetheless, despite the fact that the national and non-national mothers, all of whom delivered in the Coombe Women's Hospital (2004-2006), experienced similar support from the health professionals in the hospital, a small decline in the 'any' breastfeeding rate was observed in the non-national, compared to the national mothers from initiation (79.6%) to hospital discharge (77.5%) and to 4-weeks (75.5%).

Differences between the National and Non-National populations

The fact that all the national and non-national mothers included in the final analysis were healthy mothers who gave birth to term healthy singleton infants in a homogenous hospital environment (see **Sections 2.4.3** and **2.6.2**) allows a clear comparison between the two populations. As demonstrated in **Table 4.1** differences in the proportions of non-national and nationals who attended the public, semi-private and private ante natal clinics in the hospital during 2004 were observed. Although both the national and non-national populations consisted of mixed socio-economic groups (see **Table 3.1**), a greater proportion of national mothers attended the semi-private and private clinics (51.4%) than non-nationals (28.5%) with a clear over-representation of the non-national mothers attending the public clinics (71.4%). Despite the fact that lower breastfeeding rates have been reported among mothers who attend public compared to private clinics in others studies (Fitzpatrick *et al.,* 1994), this pattern was not observed in the non-national mothers in the present study. Moreover, relative to the Irish breastfeeding rates available from existing data (see **Table 1.2** and **Figure 1.2)** the over-representation of the national mothers who attended private and semi-private clinics did not appear to greatly increase the breastfeeding rates in the national population.

Table 4.1. Comparison of the proportion of Mothers who attended the ante natal clinics in the Coombe Women's Hospital, Dublin (2004-2006) and in the study populations

Attendance to specific clinics	2004* %	2005* %	2006* %	Nationals (n = 401) %	Non-National (n = 49) %
Public clinics	58	56	58	48.6	71.4
Semi-private clinics	16	17	17	37.2	22.4
Private clinics	26	27	25	14.2	6.1

* Coombe Women's Hospital IT and Statistical Department Reports (2004-2006)

In addition, an examination of the differences between the national and non-national populations outlined in **Table 3.3** and **Table 3.4** suggests that no significant differences were observed in terms of the gestational age of infants at birth (*p=0.077*), type of delivery (*p=1.000*), birth anthropometric measurements nor in the ages of the national and infants of non-national mothers at the 6-week (*p=0.300*) and 6-month (*p=0.503*) follow-up. Thus the infant and birth characteristics may not explain the significant differences in breastfeeding initiation nor in the 'any' breastfeeding rates observed in the two populations. The results also show that non-national compared to national mothers were significantly more likely to have been married (*p=0.042*) with public health insurance (*p=0.01*), to have been 'stay at home mothers' (*p=0.003*) and be non-smokers (*p = 0.001*). Interestingly, a significantly greater proportion of non-national (22.4%) compared to national partners (9.5%) (*p=0.00*5) were educated to post-graduate level (*p=0.005*), however, no differences were detected in terms of maternal education level (*p=0.079*) between the two populations (see **Table 3.1**). The strong and positive influences of the paternal education level, more positive health behaviours as well as the fact that more non-national than national mothers were ‘stay at home mothers’ may be considered as possible reasons for the differences in initiation and prevalence rates between the two study populations in the present study. It is highly likely however, that differences in the cultural acceptability of breastfeeding in the non-national, compared to the national population and the perception that breastfeeding is the ‘norm’ rather than a social ‘taboo’ contributed to their higher breastfeeding rates (Loh *et al.,* 1997). The non-national mothers clearly retained their beliefs from their country of origin about the positive functional benefits of breastfeeding. In addition, the past two generations in Ireland have experienced low exposure to breastfeeding, thus many maternal grandmothers in recent times have no practical experiences with breastfeeding, resulting in a loss of traditional practice, knowledge and support for national mothers who initiate breastfeeding.

It is also relevant that the duration of hospital stay was significantly ($p=0.05$) shorter among the non-national (mean 3.26 days) compared to the national (mean 3.78 days) mothers suggesting that shorter duration in the hospital among non-national mothers did not impact negatively on the ‘any’ breastfeeding rate in this population. Furthermore, ‘in-hospital support’ for breastfeeding mothers in the Coombe Women’s Hospital, or the lack thereof, may not be a major reason for the low initiation and ‘any’ breastfeeding rates observed in the national mothers who delivered in this hospital. The fact that the vast majority of non-nationals initiated breastfeeding post birth and that the ‘any’ breastfeeding rate was maintained from hospital discharge to 4-weeks suggests that an environment that enables breastfeeding in this population exists and ultimately supports continued breastfeeding during the first 6-months. It is also likely that the determination and perseverance to breastfeed was higher among the non-nationals, compared to the nationals, in spite of the fact that the culture in Ireland is not conducive to breastfeeding (Connolly *et al.,* 1998).

'Partial breastfeeding rates'

Another finding in this study was the observation of higher partial breastfeeding rates in non-national compared to national mothers from hospital discharge (26.5% and 6.5% respectively) to 6-months (46.9% and 9.4% respectively). This may suggest that partial rather than exclusive or predominant breastfeeding is generally a more common practice in the non-national population, a practice which clearly contributed to the maintenance of their breastfeeding rates during the first 6-months. The interval between 12 and 16 weeks in the present study represents a particular increase in the partial breastfeeding rate among non-national mothers (22.4% to 34.7%) accompanied by a prominent shift from a low solid intake with breast and/or formula milk at 12-weeks to a higher solid intake with breast and/or formula milk at 16-weeks. It could be deduced that the introduction of solid foods at 12-weeks in the non-national population, a time when infants experience a growth spurt, may be a preferred mother-led response to the infants' increased appetite rather than the complete cessation of breastfeeding.

'Any breastfeeding rates'

In comparison with previous Irish research which involved the recruitment and follow-up mothers who delivered in the same hospital as those in the present study (Coombe Hospital, n = 121), Freeman (1996) reported an 'any' breastfeeding rate of 26% and an exclusive breastfeeding rate of 18% at 4-weeks with a further 18% 'any' breastfeeding rate at 12-weeks. Based on these rates, our results indicate a 2% increase in the 'any' and exclusive rates at 4 and 12-weeks during the intervening ten years. Previous Irish data have found similar 'any' breastfeeding rates at 6-weeks including 20% (Howell *et al.,* 1996) and 22% (Mid-Western Health Board, 1997), to those found among nationals in the present study (24.4%), further indicating a lack of progress in terms of breastfeeding promotion.

It is also a concern that less than 10% of national mothers were offering ‘any’ breast milk to their infants at 6-months, whereas this was less of an issue in non-nationals (46.9%) offering ‘any’ breast milk at this time point. In agreement with previous regional Irish studies (Mid-Western Health Board Survey, 1997; Twomey *et al.,* 2000), ‘any’ breastfeeding rates of 6% and 8% respectively have been reported. Although the ‘any’ and exclusive breastfeeding rates are low internationally, the ‘any’ breastfeeding rate at 6-months in the national mothers was particularly low in contrast to higher rates reported by Li *et al.,* (2005) in the USA (35%), Brekke *et al.,* (2005) in Sweden (79%) and Lande *et al.,* (2003) in Norway (80%). Above all, in reference to the breastfeeding targets set out by the National Breastfeeding Committee (1994) including an initiation rate of 50% by the year 2000 and a rate of 30% at 4-months by the year 2000, results from the present study highlight that current breastfeeding practices fall short of these goals. Moreover, an examination of adherence to the WHO (2001) recommendation reveals an extremely low level of compliance, with only one national mother exclusively breastfeeding at 6-months. Furthermore, no significant differences were observed in the duration of exclusive breastfeeding between the national and non-national populations ($p = 0.510$). Encouraging mothers to attempt breastfeeding post birth seems a more pertinent measure for promoting breastfeeding rates than recommending exclusive breastfeeding to 6-months.

Finally, the results suggest that the critical period for the cessation of breastfeeding is between initiation and 4-weeks in national mothers, while non-nationals appear to maintain ‘any’ breastfeeding throughout the first 6-months. The fact that both the ‘any’ and exclusive breastfeeding rates in the national and non-national populations were maintained between 6 and 8 weeks in the present study may indicate a degree of established breastfeeding success in these mothers from the 6-week time point. Moreover, it is well acknowledged that it takes between 4 to 6 weeks to establish breastfeeding fully, and the first week post birth can be the most challenging (Kalnins, 2007b). Prioritizing and investing increased support for mothers both in-hospital and in the community during the first 6-weeks, with particular attention to the initial days at home from the hospital, may prove an effective primary strategy to maintaining the breastfeeding rates post birth. Ensuring the provision of daily home visits by the PHN, or at least telephone contact with mothers in the community, as well as the encouragement to attend weekly breastfeeding classes during the initial 6 weeks may increase mothers' confidence to persevere with breastfeeding. Learning the practical skill of breastfeeding will only be achieved by increased contact with trained health professionals and more exposure to other mothers who have already mastered the skill. Increasing the number of in-hospital and community lactation consultants would be crucial to this support strategy. The implementation and support of a national 24-hour breastfeeding helpline may also provide a critical resource to mothers at a time when their decision to discontinue breastfeeding is determined by practical concerns and the need for professional support. Based on our findings, instilling the marked benefits of exclusive and prolonged breastfeeding in national and non-national mothers, both ante and post natally may promote longer duration of breastfeeding, however, persuading mothers to breastfeed initially seems the greater challenge.

Strengths and limitations of the study

The positive features of this study included the high follow-up response rates (95% at 6-months) and the consistent and strict use of breastfeeding definitions. Furthermore, the ages of the infants of the national and non-national mothers at the 6-week and 6-month follow-up time points did not differ significantly. The fact that one investigator conducted the interviews with mothers may have reduced any inter-observer variation that may have occurred had a team of investigators been involved. However, since the study sample was not representative of a national sample of mothers, results from the present study cannot be generalized to other regions in Ireland. The possibility that low breastfeeding rates may be specific and localised to mothers living in the west Dublin region compared to the south or north Dublin region must also be considered. Our results strongly suggest that the conduct of a nationally representative infant feeding study in Ireland would be worthy of further investigation.

The fact that there was an under-representation of National mothers (48.6%) and an over-representation of Non-National mothers (71.4%) among those who attended the public clinics in the present study, relative to the population of mothers who attended the Coombe public clinics 2004 - 2006 (average 57%, 2004-2006) must be mentioned. Increased recruitment of national mothers from public clinics in the present study may have better represented the actual profile of mothers who attended the Coombe Women's Hospital (2004 - 2006). However, it is likely that breastfeeding rates may have been even lower than those reported in this study as maternal attendance at public clinics has been indicated as a risk factor for formula feeding rather than breastfeeding uptake (Fitzpatrick *et al.,* 1994). Finally, long term recall of breastfeeding data has been found to be inaccurate (Bland *et al.,* 2003) and it is possible that the reporting of the feeding status of some infants at 4, 8, 12, 16 and 20 weeks in particular, was influenced by maternal memory bias. The extent to which this possible recall bias influenced the breastfeeding rates from 6-weeks to 6-months is unknown, however, the accuracy of the feeding status at 6-weeks and 6-months can be assured.

4.6 Conclusions

This study has provided much needed data on breastfeeding initiation, prevalence and duration rates. In comparison with previously reported regional breastfeeding rates, it appears from our data that the breastfeeding initiation and prevalence rates have increased little, with a particular reluctance observed among national mothers to continue breastfeeding to 6-months post partum. Our results suggest that national efforts to promote breastfeeding in the national mothers recruited in this study have been unsuccessful. The fact that only one national mother exclusively breastfed at 6-months indicates an extremely low compliance with the WHO (2001) recommendations.

Conversely, findings clearly indicate that infants born to non-national mothers receive breast milk for a longer and more sustained length of time with partial breastfeeding being the most common breastfeeding practice in these mothers. Our results highlight that the cultural component of breastfeeding uptake and duration may be the single and most crucial determinant of breastfeeding intention, initiation and success among mothers in Ireland. It is a further problem that at least one generation in Ireland has not experienced nor been exposed to breastfeeding. Undoubtedly, a paradigmatic shift towards a more positive and accepting breastfeeding culture is required if national breastfeeding rates are to improve.

Chapter 5

Determinants of Breastfeeding Initiation and Duration among National Mothers

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5.1 Introduction

Breastfeeding is promoted as the optimal mode of infant feeding for both term and preterm infants (Fewtrell, 2004). Despite public health efforts to increase the prevalence of the practice, existing literature indicates that Irish breastfeeding initiation and duration rates have remained persistently low over the last number of decades (see **Table 1.2**). In particular, a steep decline in breastfeeding rates during the initial weeks post partum appear a consistent trend among mothers in Ireland (Loh *et al.,* 1997; Ward *et al.,* 2004).

According to Yngve & Sjostrom (2001b), country-specific knowledge about the type and importance of the determinants for breastfeeding is essential for building effective promotion programmes. However, the current consensus is that knowledge gaps exist within the public health domain that demand further investigation to explain the persistently low breastfeeding rates in Ireland (Department of Health and Children, 2005). The fact that few Irish studies have comprehensively investigated the determinants of breastfeeding initiation and duration increases the need to examine the factors related to breastfeeding success as well as the barriers that prevent mothers from attempting the practice. Evidence relating to the reasons for premature discontinuation is also lacking. Moreover, with a greater propensity towards smaller families and an increased proportion of mothers working outside the home (CSO, 2006), it is crucial to explore the influence of mothers' employment status on their feeding decisions.

In order to change policy and impact on our culture and society, well-designed research must first identify the deficiencies in our current system. Incorporating a range of potential determinants that may predict breastfeeding initiation and duration including socio-demographic, health care-related attributes, social and cultural considerations, along with maternal perceptions and attitudes allows a detailed evaluation of the factors that influence mothers' feeding decisions in the Irish-specific context. The provision of such data will facilitate insight into the most effective means to improve breastfeeding rates in our population and could also guide the development of effective interventions to revitalize a currently non-breastfeeding culture.

5.1.1 Ante natal breastfeeding information and support for mothers attending the Coombe Women's Hospital, Dublin

At the first booking ante natal visit to the Coombe Women's Hospital, midwives routinely provide pregnant mothers with verbal and written information on breastfeeding, and it is assumed that all mothers will breastfeed. Attendance at ante natal classes is also encouraged. Breastfeeding literature is on view and available to all parents attending the public, semi-private and private ante natal clinics in the hospital.

Around 30 weeks gestational age, a series of five weekly ante natal classes are available free of charge to all pregnant women who attend the hospital; however, some mothers may opt to attend community ante natal classes in their locality. Refresher ante natal classes are available for multi-parous mothers between 34-36 weeks gestational age and partners, friends or family members are welcome to all midwife-led ante natal classes.

A specific ante natal class is dedicated to breastfeeding and is designed to assist mothers with the practicalities of the practice. Information is imparted pertaining to breastfeeding positioning and normal feeding patterns. In addition, advice relating to weaning infants onto solids is given, incorporating the recommended timing of weaning and first foods, along with the discouragement of early weaning. The midwife also advises parents to consult with a health professional prior to the introduction of solids into their infant's diet.

Mothers who have had a previous negative breastfeeding experience or who have particular issues are referred from the ante natal clinics by the midwife or obstetrician to the lactation consultant in the hospital. These women are given specific advice and assistance and are seen by the midwife specialist post birth.

One full-time lactation consultant is employed in the Coombe Women's Hospital (Breastfeeding Friendly Hospital Initiative [BFHI] membership). Beyond the support from the hospital, there is no community lactation consultant available in west Dublin.

5.1.2 Post natal breastfeeding support for mothers attending the Coombe Women's Hospital, Dublin

Irrespective of the feeding intention, all infants are handed to their mothers immediately post birth for skin-to-skin contact, unless contra-indicated. Uninterrupted skin-to-skin contact is continued for the duration of 60 minutes post birth. Mothers are assisted with the first breastfeed as soon as possible, or as soon as the infant shows signs of wanting to feed. On the post natal ward, all mothers 'room-in' with their infants. Mothers who are experiencing difficulties with breastfeeding are provided with midwife support at ward level, and are encouraged to attend the in-hospital breastfeeding post natal class. The lactation consultant assesses and supports those who are experiencing specific problems. The morning after the delivery, mothers are provided with:

- ✓ Details of the post natal breastfeeding classes while in the hospital (times, location).
- ✓ Name and telephone number of the local health centre in mother's area.
- ✓ Details of breastfeeding support groups facilitated by the public health nurses (PHNs) along with details of voluntary breastfeeding groups in mother's area.
- ✓ Contact telephone numbers for post-discharge advice and assistance from the hospital. Mothers are also given a BFHI 'Breastfeeding for New Mother's Booklet'.
- ✓ Correct breastfeeding and hand expressing techniques, and details for breast pump hire.

5.1.3 Breastfeeding support post hospital discharge

The ward midwife forwards the mother's contact details to the local PHN who is also informed of the mother's hospital discharge date. In keeping with protocol (see **Appendix XII**), the PHN makes contact with mothers within 48 hours post discharge from the maternity hospital to arrange a post natal mother/infant home assessment. Particular support is provided to first time and breastfeeding mothers. In addition to the PHN home visits during the initial few weeks post birth, breastfeeding mothers are also advised to attend the local public health centre on day 7 and 14 post birth for further follow-up. The PHNs also facilitate weekly breastfeeding support groups.

In addition, mothers who encountered breastfeeding problems during their hospital stay are followed up post discharge in one of the following ways:

- ✓ The clinical manager on the post natal ward completes a referral form or makes a telephone call to the PHN requesting an urgent visit/assessment of the mother.

- ✓ Follow-up telephone call made by the clinical midwife specialist, and further calls or returns visits to the home, where distance and circumstance allow. Mothers are always advised of the in-hospital assistance available to them including the midwife support in the baby clinic and the midwife specialist, who is based in the hospital.

- ✓ Irrespective of the length of time from delivery, breastfeeding mothers are encouraged to telephone the hospital/midwife specialist during the daytime working hours for guidance, advice and support.

- ✓ Mothers who telephone the hospital for support or advice during the night are referred to the night sister or the midwife on the post natal ward, on which they were a patient. The midwife specialist is informed of mothers who require support or follow-up.

5.2 Aims and objectives

The aim of this study was to examine the factors that predict breastfeeding initiation and duration among national mothers during the first 6-months post partum, using the baseline socio-demographic, health behavioural and attitudinal data collected during the ante natal period, and the post natal data collected at the 6-week and 6-month follow-up. The specific objectives were to:

- ✓ Investigate the determinants of breastfeeding initiation, and 'any' breastfeeding at 6-weeks in a sample of national mothers
- ✓ Document mothers' reasons for choosing to initiate, and choosing not to initiate breastfeeding
- ✓ Report mothers' reasons for discontinuing breastfeeding during the first 6-weeks, and between 6-weeks and 6-months post partum
- ✓ Socio-demographically profile the mothers who were offering 'any' breast milk to their infant at 6-months post partum

5.3 Methodology

Details of the study methodology and population are provided in **Chapters 2** and **3** respectively. In keeping with the study inclusion criteria (see **Section 2.6.2**), all mothers in the present study were healthy and their singleton offspring were term, healthy infants who weighed ≥ 2.5 kg and delivered in the Coombe Women's Hospital, Dublin 8. Only the 'national mothers' (n = 401) were included in the analysis for the present chapter.

Definitions of breastfeeding were strictly used in this study, in accordance with those outlined in **Section 4.3.1.** The potential determinants of breastfeeding initiation and duration were elicited from the mothers' responses to Questionnaires 1 (ante natal period, see **Appendix VIII**), 2 (6-week follow-up, see **Appendix IX**) and 3 (6-month follow-up, see **Appendix X**). The questionnaires were designed to identify the feeding status of the infants from birth to 6-months post partum and to collect information on the variables that are suggested to be associated with breastfeeding initiation and duration (Meyerink & Marquis, 2002). **Table 5.1** provides an outline of the determinants included in the analyses of the present study. Owing to the vast number of tables created from the univariate analyses, it was not possible to include all the tables in this thesis; however, the most important findings from the univariate analyses are described in **Section 5.4.1** and **5.4.3,** with a greater focus on the independent predictors of initiation and 'any' breastfeeding at 6-weeks within these sections.

Table 5.1. The determinants related to breastfeeding initiation and duration included in the univariate and multivariate analyses in the present study

Socio-demographic factors

Maternal demographic characteristics:
Age, health insurance status, marital status, living arrangement with partner, education level, social class (based on occupation, see **Section 2.9**), parity, planned/unplanned pregnancy, reported BMI

Paternal socio-demographic characteristics:
Age, education level, social class (based on occupation, see **Section 2.9**), reported BMI

Maternal health behaviours during pregnancy:
Smoking status, number of cigarettes smoked per day, alcohol consumption, number of alcohol units consumed per week, timing of commencement of folic acid supplement

Ante and post natal care:
Timing of mother's first ante natal visit to the Coombe Women's Hospital, attendance to the ante natal classes, number of ante natal classes attended during the pregnancy, duration of hospital stay post partum

Maternal ante natal attitudes to infant feeding:
Knowledge as to the most beneficial mode of feeding for infants, mothers' ante natal attitudes to breastfeeding, 'exposure' to other mothers' breastfeeding, mothers' perception of the acceptability of breastfeeding in certain situations (in a restaurant, in a public park, in shopping centre, on a bus, in front of other men, in front of her partner, in front of other children)

Maternal ante and post natal infant feeding influences and sources of feeding information
Ante natal sources of infant feeding information
Ante natal influences on infant feeding
Post natal influences on infant feeding

PHN denotes the 'public health nurse'
GP denotes the 'general practitioner'

Table 5.1. continued: The determinants related to breastfeeding initiation and duration included in the univariate and multivariate analyses in the present study

Infant characteristics:
Gestational age at birth, size of infant for gestational age, gender, birth weight, birth length, birth head circumference, birth Ponderal Index, presence of neo natal jaundice post birth
Infant weight at 6-weeks post partum, infant 'weight gain' from birth to 6-weeks post partum

Mothers' employment status and related factors:
Ante natal expectation of post partum work status, ante natal expectation of the timing of work return post partum, ante natal perception of the influence of work return on the feeding pattern post partum, employment status at 6-months post partum, timing of work return during the first 6-months post partum

Mothers' infant feeding history:
'Ever' breastfed previous infants, feeding mode of previous infant, breastfeeding duration among mothers who breastfed their previous infant, feeding mode of mother when she was an infant, ante natal infant feeding intention regarding the current pregnancy, timing of infant feeding decision, ante natal expectation of breastfeeding duration post partum

Social support and influences from family and friends:
Ante natal infant feeding discussion with partner, feeding mode encouraged by the partner during the ante natal period, influence of the partners attitude on mothers feeding choice during the ante natal period, feeding mode encouraged by the maternal grandmother, feeding mode encouraged by the partner post natally, friends experiences with breastfeeding

Biomedical characteristic:
Type of delivery, anaesthetic use during the birth, type of anaesthetic used during the birth

Hospital practices:
Duration of hospital stay post partum, timing of first breast feed post birth, occurrence of skin-to-skin contact and rooming-in post birth, mothers' satisfaction with the breastfeeding assistance received from the midwives in hospital

Post partum factors related to the current pregnancy:
Mothers' perception of the adequacy of breastfeeding support at 6-weeks post partum
Principal social support individuals/network in mothers life during the first 6-weeks post partum
Principal infant feeding information sources utilized by mothers during the first 6-weeks post partum
Maternal supplement use during the first 6-weeks
Number of home visits from the PHN during the first 6-weeks
Number of visits to the GP during the first 6-weeks
Among the breastfeeding mothers, number of visits to the Breastfeeding Support Group
Maternal illness during the first 6-weeks
Infant illness during the first 6-weeks

PHN denotes the 'public health nurse'
GP denotes the 'general practitioner'

5.3.1 Statistical analysis

Data analysis was performed using SPSS (SPSS, Chicago IL, USA). Using the variables outlined in **Table 5.1,** a univariate analysis was carried out to explore the factors that were significantly associated with breastfeeding initiation (n = 189) and 'any' breastfeeding at 6-weeks (n = 98). Univariate analyses included contingency table analysis using Chi-Squared tests to assess the association between the categorical variables using $P < 0.05$ as the cut off for significance. Following this exploration of the data, a multivariate analysis was performed using only the factors that were significant in the univariate analyses ($P < 0.05$). In agreement with the literature on breastfeeding (Ingram *et al.,* 2002), binary logistic regression was then used to determine the variables that independently predicted breastfeeding initiation and 'any' breastfeeding at 6-weeks.

Breastfeeding initiation and 'any' breastfeeding at 6-weeks were defined as the dependent variables and the independent variables were those that were highlighted as being significant in the univariate analysis. In predicting breastfeeding initiation in the logistic regression analyses, the codes *1=initiated breastfeeding* and *0=did not initiate breastfeeding* were created and binary logistic regression was used to calculate the odds ratios (OR's) and 95% confidence intervals. Similarly, in predicting 'any' breastfeeding at 6-weeks, the codes *1= any breastfeeding at 6-weeks* and *0=non-breastfeeding at 6-weeks* were created. Consistent with previous research, multiple forward stepwise logistic regression was performed (Waldenstrom & Aarts, 2004) using SPSS for Windows. In order to examine independent associations between the explanatory variables and the dependant variables, multivariable models were developed based upon constructs from existing literature (Losch *et al.,* 1995; Scott *et al.,* 2001; Yngve & Sjostrom, 2001b; Dennis, 2002) and the significant results from the multivariate analyses in the present study. Factors were retained in the model if they were significant at the $P < 0.05$ criterion. The first run of the logistic regression model incorporated the key variables that were identified during the univariate analysis. These variables were entered singly into the regression model. Only the variables that showed statistical significance in the multivariate model were introduced into the final regression models. The importance of each variable, adjusted for the others in its group, was assessed by the Wald χ^2 and the odds ratios (OR) with 95% Confidence Interval (CI). The overall fit of a logistic regression model was assessed using the 'log-likelihood statistic' (-2LL). According to Field (2005b), large -2LL values indicate a poorly fitting statistical model, thus, a decrease in the -2LL value following the addition of a variable indicates that the model is predicting the outcome variable more accurately.

Separate final regression models were created which examined and illustrated different determinants related to the dependant variables. The most significant determinants included socio-demographic, psychosocial, attitudinal, infant feeding history-related attributes and maternal influences. Consistent with previous investigations (Gudnadottir *et al.,* 2006), the logistic regression socio-demographic models that predicted 'breastfeeding initiation' controlled for maternal age, education, smoking status, parity and infant birth weight enabling the identification of the 'independent predictors of breastfeeding initiation' while the models that predicted 'any' breastfeeding at 6-weeks controlled for maternal age, education, parity, smoking status and paternal social class.

The profiling of mothers who were still breastfeeding at 6-months (n = 39) was performed in the final section of this chapter. Chi-squared tests were used to test for significant differences between 'any' breastfeeding at 6-months and the categorical variables. The Yates's continuity correction value was used for all 2x2 tables. Significant variables were those that met the criterion $P < 0.05$.

5.4 Results

5.4.1 Determinants of breastfeeding initiation (n = 189)

The univariate analysis revealed that the vast majority of maternal and paternal socio-demographic characteristics were significantly (*p=0.000*) associated with breastfeeding initiation including maternal age, social class, health insurance status, education level, parity, along with paternal age, education level and social class. After adjustment, all the aforementioned variables, with the exception of father's age, remained statistically significant ($p<0.05$) in the multivariate analysis, with primi-parous, married mothers ≥ 35 years, having private health insurance status, educated to third level education and in Social Class 1 being more likely to initiate breastfeeding.

The infants of mothers who did not initiate breastfeeding were significantly more likely to have been a small size for gestational age (14%) and to have had a birth weight ≤ 2.99 kg (21%) compared to the infants of mothers who did initiate breastfeeding (2% and 7% of infants respectively); however, after adjusting for smoking status, mother's age, education level and parity, these associations disappeared in the multivariate analysis. In the unvariate analysis, no significant differences were observed between the two groups in terms of infant gender (*p=0.277*), the incidence of neo natal jaundice post birth (*p=0.474*), type of delivery (*p=0.778*) nor anaesthetic use (*p=0.971*) during the birth.

The majority of mothers who initiated, compared to those who did not initiate breastfeeding, were significantly (*p=0.000*) more likely to have ante natally expected to return to work post partum (81.5% versus 65% of mothers respectively) and to have ante natally perceived that work return would influence the feeding pattern post partum (51% versus 6.5% of mothers respectively) (*p=0.000*). After adjustment in the multivariate analysis, mothers who initiated breastfeeding were still more likely to have reported ante natally that return to work would influence their feeding pattern (OR 13.03, $p = 0.000$).

Mothers who initiated, compared to those who did not initiate breastfeeding, were significantly ($p=0.000$) more likely to have 'ever breastfed' a previous infant (35% versus 5% of mothers respectively), to have been breastfed themselves as infants (27.5% versus 7% of mothers respectively) and to have ante natally intended to breastfeed post partum (94% versus 6% of mothers respectively). Both in the univariate and multivariate analysis ($p=0.000$), the vast majority of mothers who did not initiate breastfeeding had made their infant feeding decision pre-pregnancy (74%) while half of the mothers (50%) who initiated breastfeeding had made their decision post birth.

The majority of mothers who initiated, compared to the non-initiators, were significantly more likely ($p=0.000$) to have had a partner who ante natally encouraged breastfeeding (75% versus 17% of mothers respectively), to have been positively encouraged to breastfeed by the maternal grandmother (41% versus 13% of mothers respectively) and to have had friends who breastfed (78% versus 51% of mothers respectively). After adjustment in the multivariate analysis, these associations remained ($p=0.000$), with ante natal encouragement from the partner (OR 14.48) and the maternal grandmother (OR 6.24) identified as particularly positive influences on breastfeeding initiation.

The univariate analysis demonstrated that mothers who initiated breastfeeding were significantly more likely ($p=0.000$) to have reported that they had seen their sisters (26.5%) and friends (61%) breastfeeding, and to have reported that breastfeeding was the most beneficial feeding mode for infants (96%) ($p = 0.000$). In addition, these mothers reported more positive attitudes towards breastfeeding ($p=0.000$), with the majority reporting that it was 'natural' (56%) compared to fewer non-breastfeeding mothers (37%). Conversely, the majority of those who did not initiate breastfeeding reported that is was 'embarrassing' (60%) compared to fewer breastfeeding mothers (38%) (*p=0.000*). After adjustment in the multivariate analysis, responses to breastfeeding being 'natural' (OR 2.35) positively influenced initiation while 'embarrassing' was indicated as a negative determinant (OR 0.43) (*p=0.000*).

Similarly, significant differences (*p=0.000*) were observed between those who initiated, and those who did not initiate breastfeeding, in terms of mothers' perception of the acceptability of practice in a restaurant (44% and 16% of mothers respectively), shopping centre (47% versus 19% of mothers respectively) and in a public park (53% and 21% of mothers respectively). Positive responses to the acceptability of breastfeeding in a restaurant (OR 3.79), shopping centre (OR 3.46) and public park (OR 3.29) remained strong positive determinants of initiation after adjustment in the multivariate analysis (*p=0.000*).

The majority of mothers who initiated breastfeeding were significantly (*p=0.000*) more likely to have attended ante natal classes (65%) and to have had a partner who attended the classes (47%) compared to those who did not initiate breastfeeding (36% versus 28% of mothers and partners respectively); however, these associations were not significant after adjustment in the multivariate analyses (*p=0.06* versus *p=0.472* respectively). A greater proportion of mothers who initiated, compared to those who did not initiate breastfeeding, reported that the ante natal classes (34%), books/infant feeding magazines (44%) and the hospital midwives (32%) were principal sources of ante natal infant feeding information compared to their non-breastfeeding counterparts (*p=0.000*), while the maternal grandmother was reported as a source of ante natal feeding information more among the non-breastfeeding group (66.5%) compared to those who initiated breastfeeding (30%) (*p=0.000*).

Final models independently predicting 'breastfeeding initiation'

After adjustment for maternal age, education level, smoking status during pregnancy, parity and infant birth weight, the socio-demographic and maternal employment model (88.6% predictive) (see **Table 5.2**) indicates that primi-parous mothers, aged ≥ 35 years were significantly (*p=0.000*) more likely to initiate breastfeeding; however, mothers' education level was not highlighted as a significant determinant (*p=0.277*). Ante natal encouragement from the partner (OR 12.82, CI 5.14-31.99, *p=0.000*) and encouragement from the maternal grandmother (OR 6.07, CI 2.16-17.07, *p=0.001*) to breastfeed were highlighted as strong positive determinants of breastfeeding initiation. Those who reported that they made the decision to breastfeed post birth, compared to pre-pregnancy were 10.26 times more likely to initiate (CI 3.75-28.07). Mothers' ante natal perception that work return would influence the feeding pattern post partum was also highlighted as a positive determinant (OR 7.46, CI 2.49-22.38, *p = 0.000*).

Table 5.2. Binary logistic regression model examining the effect of socio-demographic factors including a maternal employment-related factor, on predicting breastfeeding initiation

Socio-demographic and Maternal Employment Model (-2LL=147.28; R^2 = 0.55; 88.6% predictive of variance)	**ß**	**Sig.**	**OR**	**95% C.I.**	
				Lower	**Upper**
Mothers' education level					
Primary & secondary ^		0.277			
Vocational/training course	+	0.302	1.79	0.59	5.40
Third level degree/post graduate level	+	0.114	2.29	0.81	6.41
Mothers' age group (yrs)					
≤ 24 ^		0.000			
25-34	+	0.159	2.31	0.72	7.46
≥ 35	+	0.000	43.71	7.3	261.55
Parity					
Multi-parous mothers ^					
Primi-parous mothers	+	0.000	6.49	2.45	17.15
Birth weight					
≤ 2.99 kg ^		0.309			
3-4 kg	+	0.134	2.93	0.71	11.9
> 4 kg	+	0.177	3.00	0.60	14.7
Smoking status					
Smoked during pregnancy ^					
Did not smoke during pregnancy	+	0.240	2.18	0.59	8.04
Feeding mode encouraged by the partner ante natally					
Did not encourage breastfeeding ^					
Positively encouraged breastfeeding	+	0.000	12.82	5.14	31.99
Feeding mode encouraged by the maternal grandmother					
Did not encourage breastfeeding ^					
Positively encouraged breastfeeding	+	0.001	6.07	2.16	17.07
Timing of when mother made her infant feeding decision regarding the current pregnancy					
Before the pregnancy ^		0.000			
During the pregnancy	-	0.284	0.42	0.09	2.02
Post birth	+	0.000	10.26	3.75	28.07
Mothers' ante natal perception of the influence of work return on feeding pattern					
Work return will not influence feeding pattern ^					
Work return will influence feeding pattern	+	0.000	7.46	2.49	22.38

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

Table 5.3 explored the acceptability of breastfeeding in public, indicating that mothers who reported that it was acceptable to breastfeed in a restaurant were over 4 times more likely to have initiated post partum (OR 4.52, CI 1.45-14.06, *p = 0.009*).

Table 5.3. Binary logistic regression model examining the effect of socio-demographic, social and psychocultural factors* on predicting breastfeeding initiation

Socio-demographic and Psychocultural model (-2LL= 139.88; R^2 =0.56; 89.4% predictive of variance)	**ß**	**Sig.**	**OR**	**95% C.I. Lower**	**95% C.I. Upper**
Mothers' education level					
Primary & secondary ^		0.335			
Vocational/training course	+	0.164	2.23	0.72	6.9
Third level degree/post graduate level	+	0.285	1.79	0.61	5.2
Mothers' age group (yrs)					
≤ 24 ^		0.000			
25-34	+	0.186	2.18	0.68	6.99
≥ 35	+	0.000	35.59	5.84	216.91
Parity					
Multi-parous mothers ^					
Primi-parous mothers	+	0.000	8.93	3.12	25.55
Birth weight					
≤ 2.99 kg ^		0.154			
3-4 kg	+	0.058	3.99	0.95	16.67
> 4 kg	+	0.093	4.01	0.79	20.39
Smoking status					
Smoked during pregnancy ^					
Did not smoke during pregnancy	+	0.465	1.61	0.44	5.86
Feeding mode encouraged by the partner ante natally					
Did not encourage breastfeeding ^					
Positively encouraged breastfeeding	+	0.000	12.04	4.66	31.12
Feeding mode encouraged by the maternal grandmother					
Did not encourage breastfeeding ^					
Positively encouraged breastfeeding	+	0.001	6.3	2.19	18.13
Timing of when mother made her infant feeding decision regarding the current pregnancy					
Before the pregnancy ^		0.000			
During the pregnancy	-	0.223	0.393	0.08	1.76
Post birth	+	0.000	11.11	3.9	31.6
Mothers' ante natal perception of the influence of work return on feeding pattern					
Work return will not influence feeding pattern ^					
Work return will influence feeding pattern	+	0.000	8.43	2.68	26.5
Mothers' ante natal attitude to the acceptability of breastfeeding in a restaurant					
Not acceptable to breastfeed in restaurant ^					
Acceptable to breastfeed in restaurant	+	0.009	4.52	1.45	14.06

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio
* Psycocultural factor includes: mothers attitude to the acceptability of breastfeeding in a restaurant

As shown in **Table 5.4,** mothers' positive ante natal feeding intention to breastfeed was indicated as one of the most important independent determinants (*p=0.000*) in this study with these mothers being 219 times more likely to initiate breastfeeding compared to those who did not have a positive ante natal intention to breastfeed (CI 85.11-567.87).

Table 5.4. 'Ante natal feeding intention' as a single independent predictor of breastfeeding initiation, after adjustment for socio-demographic factors

Ante Natal Feeding Intention (-2LL = 169.08; R^2=0.61; 93.8% predictive of variance)	**ß**	**Sig.**	**OR**	**95% C.I.**	
				Lower	**Upper**
Mothers' education level					
Primary & secondary ^		0.325			
Vocational/training course	+	0.144	2.14	0.77	5.97
Third level degree/post graduate	+	0.334	1.71	0.57	5.09
Mothers' age group (yrs)					
≤ 24 ^		0.016			
25-34	-	0.462	0.65	0.20	2.05
≥ 35	+	0.053	4.34	0.98	19.19
Parity					
Multi-parous mothers ^					
Primi-parous mothers	+	0.048	2.54	1.00	6.4
Smoking status					
Smoked during pregnancy ^					
Did not smoke during pregnancy	+	0.116	2.41	0.80	7.28
Mothers' ante natal feeding intention regarding the current pregnancy					
No positive intention to breastfeed ^					
Positive intention to breastfeed	+	0.000	219.84	85.11	567.87

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

The final 'maternal influences and attitudinal model' (83.2% predictive) (see **Table 5.5**) highlights that those who reported 'breastfeeding' as the most beneficial feeding mode for infants were 11.8 times more likely to initiate breastfeeding (CI 4.14-33.94) than those who reported that no differences existed between formula and breast milk (*p=0.000*).

The principal ante natal infant feeding influences indicated as being positive and independent determinants of breastfeeding initiation included the hospital midwives (*p=0.000*) and books/infant feeding magazines (*p=0.000*) while the maternal grandmother was an important post natal feeding influence (*p=0.006*). As shown in **Table 5.5**, mothers who reported that breastfeeding was not embarrassing (*p=0.021*), and who had witnessed the maternal grandmother breastfeeding (*p=0.017*) were significantly more likely to have initiated breastfeeding.

Table 5.5. Binary logistic regression model examining the effect of maternal ante natal infant feeding attitudes, exposures to breastfeeding practice, ante and post natal sources of influence and infant feeding information on predicting breastfeeding initiation

Maternal Influences and Attitudinal Model (-2LL = 254.17; R^2= 0.47; 83.2% predictive of variance)	**ß**	**Sig.**	**OR**	**95% C.I.**	
				Lower	**Upper**
Mothers' education level					
Primary & secondary ^		0.380			
Vocational/training course	+	0.243	1.59	0.72	3.50
Third level degree/post graduate	+	0.214	1.68	0.74	3.80
Mothers' age group (yrs)					
≤ 24 ^		0.000			
25-34	+	0.007	3.65	1.42	9.38
≥ 35	+	0.000	15.40	4.54	52.29
Parity					
Multi-parous mothers ^					
Primi-parous mothers	+	0.001	3.08	1.55	6.14
Smoking status					
Smoked during pregnancy ^					
Did not smoke during pregnancy	+	0.040	2.45	1.04	5.79
Most beneficial feeding method for infants					
No difference between formula and breast milk ^		0.000			
Formula feeding	-	0.171	0.24	0.03	1.83
Breastfeeding	+	0.000	11.8	4.14	33.94
Mothers' ante natal attitude to breastfeeding practice					
Embarrassing ^	+	0.021	2.11	1.11	3.99
Not embarrassing					
Exposure to the maternal grandmother breastfeeding					
No exposure ^	+	0.017	5.20	1.34	20.14
Exposure					
Mothers' ante natal infant feeding influences					
Books/infant feeding magazines*	+	0.000	5.39	2.37	12.28
Mothers ante natal infant feeding influences					
Hospital midwives+	+	0.000	6.96	2.63	18.43
Mothers post natal infant feeding influences					
Maternal grandmother &	+	0.006	7.22	1.76	29.56

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

*Regression analysis compared those who reported books/infant feeding magazines as an ante natal infant feeding influence, to those who did not report this infant feeding influence (reference group)

+Regression analysis compared those who reported the hospital midwives as an ante natal infant feeding influence, to those who did not report this infant feeding influence (reference group)

&Regression analysis compared those who reported the maternal grandmother as a post natal infant feeding influence, to those who did not report this post natal infant feeding influence (reference group)

5.4.2 Principal reasons reported by mothers for initiating breastfeeding (n = 189)

As outlined in **Table 5.6**, the infant health-related benefits of breastfeeding were highlighted as the most prevalent motivations for mothers to initiate breastfeeding (54%) followed by mother-led intrinsic personal reasons such as the promotion of bonding and a willingness to want to breastfeed (18%). The positive influence of family and friends along with re-enforcement to breastfeed from a mother's social network were indicated as important reasons for breastfeeding in 15% of cases.

Table 5.6. Mothers' reported reasons for initiating breastfeeding

Principal reasons for initiating breastfeeding	n	% of responses
Best nutrition & optimum health benefits for infant/immunity	287	54
Intrinsic mother-led reasons e.g. intuition, naturalness, instinct to want to breastfeed, promote bonding & rapport with infant	94	18
Positive re-enforcement/exposure from others to breastfeed e.g. health professionals, family, friends encouraged breastfeeding	79	15
Less organization for mother/convenience	39	7
Maternal health benefits e.g. figure regainment, decrease long-term risks of breast cancer	29	5
Economical reasons	5	1
Total	533	100

Principal reasons for not initiating breastfeeding among the mothers who chose to formula feed (n = 212)

The issue of embarrassment was highlighted as a major barrier to the initiation of breastfeeding among 31% of non-breastfeeding mothers (see **Table 5.7**). The perception that breastfeeding would be demanding and restrictive on a mother's life was also highlighted as a principal barrier to the uptake of the practice (24%). Work return (0.4%), mother or infant-related illness (3%) and fatigue post birth (3%) did not feature as major barriers to initiation among non-breastfeeding mothers in the present study. Although only 6% of mothers reported a lack of confidence in their abilities to breastfeed as a reason for not initiating breastfeeding, a separate examination of mothers' level of confidence in being able to breastfeed, revealed that 67.5% of mothers who did not initiate breastfeeding reported that they would 'not have been confident' or 'not at all confident' in their ability to breastfeed, 10.4% of mothers were unsure and only 22.2% reported that they would have been 'confident' or 'very confident' in their abilities to breastfeed.

Table 5.7. Mothers' reported reasons for not choosing to breastfeed

Principal reasons for choosing not to breastfeed	**n**	**% of responses**
Embarrassment issue: 'wouldn't be comfortable breastfeeding in public'	226	31
Lifestyle and time issue: 'breastfeeding would be too demanding for my lifestyle'	177	24
Negative perception of breastfeeding: 'had a previous negative breastfeeding experience/exposure'	80	11
Mother's personal preference not to breastfeed	56	8
Partner related factors: 'he would feel left out', 'he should share the feeding responsibility as well'	47	6
Low confidence in being able to breastfeed	43	6
Maternal misperceptions surrounding breastfeeding	44	6
Maternal fatigue post birth/difficult birth	20	3
Mother/infant-related illness or medications/drug use contra-indicated breastfeeding	22	3
Environment and culture in Ireland not conducive to breastfeeding	11	1
Work return a possible barrier to initiation	3	0.4
Total	729	99.4

5.4.3 Determinants of 'any' breastfeeding at 6-weeks (n = 98)

Following a univariate exploration of the factors outlined in **Table 5.1** and the variable 'any' breastfeeding at 6-weeks, a number of maternal (*p=0.000*: mother's age, health insurance status, marital status, education level, social class, planned/unplanned pregnancy) and paternal (*p=0.000*: age, education level, social class) socio-demographic characteristics met the statistical cut-off for $P<0.05$. The determinants that remained significant and positively predicted 'any' breastfeeding at 6-weeks in the multivariate analysis included primi-parous (OR 1.85, *p=0.037*), mother's age ≥ 35 years (OR 4.94, *p=0.003*), educated to third level (OR 5.87, *p = 0.000*) along with paternal social class 1 (OR 2.43, *p=0.007*).

No significant associations were observed in terms of infant weight at 6-weeks (*p=0.331*), infant weight gain from birth to 6-weeks (*p=0.332*) or infant gender (*p=0.640*). However, infants who were being breastfed, compared to the non-breastfeeding group at 6-weeks, were more likely to have had a birth weight > 4kg (26.5% compared to 13.2% respectively); however, after adjustment in the multivariate analysis, this association dissipated (*p=0.136*). Biomedical characteristics such as type of delivery (*p=0.488*) and anaesthetic use (*p=0.293*) were not associated with 'any' breastfeeding at 6-weeks. Similarly, no significant associations were found between breastfeeding at 6-weeks and hospital practices such as mothers' satisfaction with the breastfeeding assistance received from the midwives (*p=0.618*), the occurrence of skin-to-skin contact (*p=0.525*) and rooming-in (*p=0.990*) post birth, nor in the timing of the first breastfeed (*p=0.131*).

Mothers' expectation of work return plan post partum (*p=0.988*), the timing as to when mothers actually returned to work during the first 6-months (*p=0.634*) and mothers' employment status at 6-months (*p=0.342*) did not appear to influence 'any' breastfeeding at 6-weeks in the univariate analysis. However, mothers' ante natal perception of the influence of work return on the feeding pattern post partum was highlighted as being significantly associated with 'any' breastfeeding at 6-weeks ($p=0.000$) and this association persisted after adjustment in the multivariate analysis (OR 3.97, $p=0.000$).

Mothers who were breastfed as infants ($p=0.000$), who had 'ever' breastfed a previous infant ($p=0.000$) and those who breastfed a previous infant for a duration > 6weeks post birth ($p=0.000$) were more likely to have been breastfeeding their infant at 6-weeks in the present study. The persisting positive influence of the aforementioned variables on 'any' breastfeeding at 6-weeks were particularly evident in the multivariate analysis, with mothers who had previously breasted being over 80 times more likely (OR 80.88, $p=0.000$) to have been breastfeeding at 6-weeks. Similar to the determinants of breastfeeding initiation, mothers who had a positive ante natal intention to breastfeed (OR 32.97, $p=0.000$) and who had ante natally expected to breastfeed for a duration >12 weeks (OR 2.15, $p=0.05$) post partum were significantly more likely to have been breastfeeding at 6-weeks. A greater proportion of breastfeeding mothers reported that they had made their decision to breastfeed pre-pregnancy (72%) compared to their non-breastfeeding counterparts (57%) ($p=0.008$).

Positive encouragement to breastfeed ante and post natally by the partner and the maternal grandmother were highlighted as being important influences on 'any' breastfeeding at 6-weeks in both the univariate ($p=0.000$) and multivariate ($p=0.000$) analysis. The partner ($p=0.031$), general family support ($p=0.042$) and the PHN ($p=0.007$) were found to provide important social support to mothers during the first 6-weeks post birth in the univariate analysis, with the positive influence of the PHN ($p=0.023$) and family support ($p=0.02$) on 'any' breastfeeding at 6-weeks persisting after adjustment in the multivariate analysis. The PHN was also indicated in the multivariate analysis as the individual that mothers would depend upon for breastfeeding advice during the first 6-weeks post birth ($p=0.004$). Mothers who reported to have had > 2 visits from their PHN during the first 6-weeks were almost twice as likely to have been breastfeeding at 6-weeks (OR 1.93, $p=0.023$) compared to mothers who received 1-2 visits. Similarly, among the mothers who initiated breastfeeding, those who ever attended the local breastfeeding support group (≥ 1 visit) were almost 3 times more likely to have been breastfeeding at 6-weeks (OR 2.74, $p = 0.028$).

Hospital leaflets providing breastfeeding information were the only infant feeding information source utilized by mothers post partum that remained positive and significant predictors of 'any' breastfeeding at 6-weeks ($p=0.037$) in the multivariate analysis. Reported infant ($p=0.465$) or maternal ($p=0.815$) illness during the first 6-weeks post birth did not appear to influence 'any' breastfeeding at 6-weeks.

A significantly ($p=0.000$) greater proportion of breastfeeding mothers at 6-weeks compared to their non-breastfeeding counterparts, reported that it was acceptable to breastfeed in front of other men (47% versus 15% of mothers respectively), in a restaurant (53% versus 22% of mothers respectively), in a shopping centre (58% versus 24% of mothers respectively) and on a public bus (34% and 15% of mothers respectively) with their persisting positive influences on 'any' breastfeeding at 6-weeks being indicated in the multivariate analysis.

A positive perception of breastfeeding being a 'natural practice' was highlighted as being a positive predictor of breastfeeding at 6-weeks (OR 3.76, $p=0.000$) whereas mothers' perception of breastfeeding being an 'embarrassing' practice negatively determined breastfeeding at 6-weeks (OR 0.29, $p=0.000$).

Final models predicting 'any' breastfeeding at 6-weeks

As highlighted in the 'socio-demographic and psychosocial model' (88.9% predictive) (see **Table 5.8**), primi-parous (OR 2.19, CI 1.06-4.52) mothers ≥ 35 years (OR 7.13, CI 1.92-26.53) educated to third level (OR 5.48, CI 2.21-13.54), with partners who were in Social Class 2 (OR 5.01, CI 1.5-16.73) were significantly more likely to have been breastfeeding at 6-weeks post partum. Positive ante ($p=0.000$) and post ($p=0.021$) natal support from the partner to breastfeed as well as positive encouragement from the maternal grandmother to breastfeed ($p=0.002$) were identified as positive independent determinants of 'any' breastfeeding at 6-weeks. Mothers who had decided to breastfeed pre-pregnancy were almost 7 times more likely ($p=0.000$) to have been breastfeeding at 6-weeks (OR 6.98, CI 3.3-14.75), compared to those who had made their feeding decision during the course of their pregnancy to the point of initiation.

Table 5.8. Binary logistic regression model examining the effect of socio-demographic and psychosocial factors on predicting 'any' breastfeeding at 6-weeks

Socio-demographic and Psychosocial Model (-2LL= 235; R^2 = 0.42; 88.9% predictive)	**ß**	**Sig.**	**OR**	**95% C.I.**	
				Lower	**Upper**
Mothers' education level					
Primary & secondary ^		0.001			
Vocational/training course	+	0.044	2.64	1.02	6.81
Third level degree/post graduate	+	0.000	5.48	2.21	13.54
Mothers' age group (yrs)					
≤ 24 ^		0.001			
25-34	+	0.562	1.37	0.46	4.03
≥ 35	+	0.003	7.13	1.92	26.53
Parity					
Multi-parous mothers ^					
Primi-parous mothers	+	0.034	2.19	1.06	4.52
Smoking status					
Smoked during pregnancy ^					
Did not smoke during pregnancy	+	0.63	1.31	0.43	3.95
Paternal social class					
Social Class 3 ^		0.029			
Social Class 1	+	0.082	2.01	0.91	4.45
Social Class 2	+	0.009	5.01	1.5	16.73
Unknown category(unemployed/students)	+	0.085	3.83	0.83	17.74
Feeding mode encouraged by partner ante natally					
Did not encourage breastfeeding ^					
Positively encouraged breastfeeding	+	0.000	5.42	2.34	12.54
Feeding mode encouraged by partner post natally					
Did not encourage breastfeeding ^					
Positively encouraged breastfeeding	+	0.021	2.53	1.14	5.58
Feeding mode encouraged by the maternal grandmother					
Did not encourage breastfeeding ^					
Positively encouraged breastfeeding	+	0.002	3.13	1.49	6.55
Timing of when mother made her infant feeding decision regarding the current pregnancy					
During the pregnancy until initiation ^					
Pre-pregnancy	+	0.000	6.98	3.3	14.75

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

Following adjustment for confounders, mothers who breastfed their previous child were over 17 times more likely (*p=0.009*) to have been breastfeeding at 6-weeks (OR 17.25, CI 2.03-146.52), highlighting the positive influence of mothers' previous breastfeeding experiences (see **Table 5.9**) on predicting breastfeeding duration.

Table 5.9. Binary logistic regression model examining the effect of Mothers' infant feeding history on predicting 'any' breastfeeding at 6-weeks

Infant Feeding History Model (-2LL= 234; R^2 = 0.44; 82.7% predictive)	**ß**	**Sig.**	**OR**	**95% C.I.**	
				Lower	**Upper**
Mothers' education level					
Primary & secondary ^		0.024			
Vocational/training course	+	0.381	1.52	0.59	3.95
Third level degree/post graduate	+	0.011	3.33	1.31	8.43
Mothers' age group (yrs)					
≤ 24 ^		0.006			
25-34	+	0.916	1.06	0.33	3.34
≥ 35	+	0.037	4.14	1.08	15.75
Parity					
Multi-parous mothers ^					
Primi-parous mothers	+	0.013	14.14	1.73	115.13
Smoking status					
Smoked during pregnancy ^					
Did not smoke during pregnancy	-	0.764	0.845	0.28	2.54
Paternal social class					
Social Class 3 ^		0.053			
Social Class 1	+	0.096	1.93	0.889	4.19
Social Class 2	+	0.048	3.5	1.01	12.15
Unknown category (unemployed/students)	+	0.045	7.29	1.04	51.07
Feeding mode of mother when she was an infant					
Not breastfed ^					
Breastfed/combination fed	+	0.015	2.59	1.2	5.59
Mothers' ante natal feeding intention regarding the current pregnancy					
No intention to breastfeed ^					
Positively intended to breastfeed	+	0.000	14.16	4.37	45.79
Feeding method of last child					
Did not breastfeed ^					
Breastfed	+	0.009	17.25	2.03	146.52

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

The ‘knowledge, exposure and attitudinal model’ (80.2% predictive) as shown in **Table 5.10** indicates that mothers who reported that breastfeeding, compared to formula feeding was the most beneficial mode of infant feeding were over 20 times more likely to be breastfeeding at 6-weeks (OR 20.91, CI 2.23-196.16, *p=0.001*). A mother’s exposure to her sister breastfeeding (*p=0.009*) as well as the perception that breastfeeding was a natural practice (*p=0.002*) were also shown to be positive determinants.

Table 5.10. Binary logistic regression model examining the effects of Mothers’ infant feeding knowledge, exposure and attitudes to infant feeding, on predicting ‘any’ breastfeeding at 6-weeks

Knowledge, Exposure and Attitudinal model (-2LL= 266 ; R^2 = 0.32; 80.2 %predictive)	**ß**	**Sig.**	**OR**	**95% C.I. Lower**	**95% C.I. Upper**
Mothers’ education level					
Primary & secondary ^		0.001			
Vocational/training course	+	0.116	2.01	0.84	4.84
Third level degree/post graduate	+	0.000	4.89	2.06	11.63
Mothers’ age group (yrs)					
≤ 24 ^		0.001			
25-34	-	0.615	0.77	0.28	2.12
≥ 35	+	0.034	3.49	1.09	11.1
Parity					
Multi-parous mothers ^					
Primi-parous mothers	+	0.074	1.82	0.94	3.53
Smoking status					
Smoked during pregnancy ^					
Did not smoke during pregnancy	-	0.833	0.898	0.33	2.43
Paternal social class					
Social Class 3 ^		0.066			
Social Class 1	+	0.051	2.06	0.99	4.26
Social Class 2	+	0.071	2.73	0.91	8.14
Unknown category (unemployed/students)	+	0.074	5.23	0.85	32.16
Most beneficial mode of feeding for infants					
Infant formula feeding ^		0.001			
Breastfeeding	+	0.008	20.91	2.23	196.16
No difference between methods/unsure	+	0.503	2.46	0.17	34.56
Sources of breastfeeding exposure					
Sister	+	0.009	2.67	1.27	5.59
Mothers ante natal attitudes to breastfeeding practice					
Natural	+	0.002	2.76	1.47	5.18

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

5.4.4 Discontinuation of breastfeeding during the first 6-weeks (n = 91)

The principal reasons for discontinuing breastfeeding during the first 6-weeks post partum, as highlighted in **Table 5.11**, related to maternal tiredness (26%) as well as to the demands of breastfeeding due to frequent feeding frequency (23%). Almost one sixth of mothers (17%) discontinued owing to their perception that they had an inadequate breast milk supply and the perception that the breast milk was not satisfying their infant's hunger. Few mothers reported work return (1%), lack of breastfeeding support and reassurance (1%), infant (4%) and mother-related illness (5%) as the principal reasons for abandoning the practice.

Table 5.11. Mothers' reported reasons for discontinuing breastfeeding during the first 6-weeks post partum (n = 91)

Reported reasons for discontinuing breastfeeding during the first 6-weeks post partum	**n**	**% of responses**
Maternal tiredness: 'getting no sleep', 'general stress'	67	26
Constant feeding/demanding/restrictions/no freedom: 'no life when breastfeeding', 'all I was doing was breastfeeding'	59	23
Perception of having an inadequate milk supply/mother's breast milk supply was 'drying up' and she felt that her supply was not satisfying the baby	46	17
Latching problems: 'infant didn't take to breastfeeding', baby wasn't a 'natural breast feeder'	30	11
Physical reason e.g. mastitis, painful/inverted nipples	21	8
Maternal related illness which interfered with successful breastfeeding e.g. anaemia or the commencement of medications such as antibiotics	12	5
Intrinsic mother-related reason e.g. embarrassment: 'didn't enjoy breastfeeding', 'felt uncomfortable in public'	10	4
Infant-related illness which interfered with successful breastfeeding e.g. jaundice, medical suspicion of galactosaemia & allergy to breast milk, infant weight loss	10	4
Lack of support & reassurance to continue breastfeeding	2	1
Work return an issue	1	1
Total	**258**	**100**

Discontinuation of breastfeeding between 6-weeks and 6-months post partum

Breastfeeding discontinuation between 6-weeks and 6-months post partum was principally associated with time constraints, restrictions, and the demands associated with breastfeeding (39%) with mothers reporting that they 'wanted an easier life' and 'more freedom' (**Table 5.12**). Maternal tiredness and general stress (13%) as well as work return (12%) featured as less prevalent reasons for discontinuation while mother/infant-related illness (3%), lack of support and reassurance with breastfeeding (1%) and the wish to include the partner in the feeding routine (1%) did not contribute as major reasons for discontinuation between 6-weeks and 6-months.

Table 5.12. Mothers' reported reasons for discontinuing breastfeeding between 6-weeks and 6-months post partum (n = 59)

Reported reasons for discontinuing breastfeeding between 6-weeks and 6-months post partum:	**n**	**% of responses**
Demands of breastfeeding/restrictive/time consuming: 'wanted an easier life and more freedom'	60	39
Tiredness/run down/general stress: 'getting no sleep'	19	13
Work return was the main issue: 'wanted to establish a formula feeding routine prior to work return'	18	12
Ready to stop/pre-pregnancy plan to feed for a set time: 'had enough of breastfeeding'	18	12
Perception of having an inadequate breast milk supply: 'supply drying up', 'formula feeding regimen reassured me that the baby was getting enough milk'	16	10
Physical reason e.g. sore breasts, mastitis, nipple problems	8	5
Embarrassment/negative cultural & public reaction to breastfeeding mothers	6	4
Illness of mother/infant: medically advised to stop owing to poor infant weight gain/medication use	4	3
Lack of support/reassurance/confidence in 'doing it right'	2	1
Partner involvement important	2	1
Total	**153**	**100**

5.4.5 Characteristics of the mothers who were offering 'any' breast milk to their infants at 6-months (n = 39)

As highlighted in **Table 5.13**, significant associations were observed between 'any' breastfeeding at 6-months (n = 39) and mothers' age (*p=0.019*), health insurance status (*p=0.000*), marital status (*p=0.002*), education level (*p=0.000*), social class (*p=0.000)* and smoking status during pregnancy (*p=0.009*). Among the mothers breastfeeding at 6-months, 72% were reported to have been educated to third level compared to 27% in the non-breastfeeding group. In addition, breastfeeding mothers, compared to non-breastfeeding mothers, were more likely 'not' to have smoked during pregnancy (95% versus 75% of mothers respectively) (*p = 0.009*).

Table 5.13. A description of the proportion of National Mothers who were offering 'any' breast milk to their infants at 6-months (n = 39) by maternal socio-demographic and health behavioural characteristics [$]

Maternal socio-demographic & health behavioural characteristics	Total sample of 401 mothers %	'Any' Breastfeeding at 6-months (n = 39) %	Non-breastfeeding mothers at 6-months (n = 362) %	Significance *p value*
Mothers' age group (yrs)				
≤ 24	22	8	24	
25-34	60	61	59	
≥ 35	18	31	17	**0.019***
Health Insurance Status				
Public	49	20	52	
Semi-private	37	44	36	
Private	14	36	12	**0.000****
Marital status				
Married	59	85	56	
Unmarried	31	13	33	
Single	10	3	11	**0.002***
Mothers' education level				
Primary & secondary	40	15	43	
Vocational/training course	29	13	30	
Third level degree/post-graduate	31	72	27	**0.000****
Maternal social class				
Social Class 1	31	61	28	
Social Class 2	31	18	32	
Social Class 3	11	5	12	
Unknown category (unemployed/students)	11	3	12	
Stay at home mothers	16	13	16	**0.000****
Parity				
Primi-parous mothers	49	51	49	
Multi-parous mothers	51	49	51	**0.883**
Maternal health behaviours during pregnancy:				
Smoking status				
Did not smoke during pregnancy	77	95	75	
Smoked during pregnancy	23	5	25	**0.009***
Alcohol consumption during pregnancy				
Alcohol consumed during pregnancy	38	28	39	
Alcohol not consumed during pregnancy	62	72	61	**0.254**

Not all categories may add up to 100% as some values were rounded up or down
* significant, *p*<0.05, ***p*<0.001

[$] The univariate analysis compares the differences between the categorical variables, and those in the 'any' and non-breastfeeding groups at 6-months

Table 5.14 indicates that older (*p=0.006*), more educated (*p=0.001*) fathers from higher Social Classes (*p=0.000*) were associated with 'any' breastfeeding at 6-months.

Table 5.14. A description of the proportion of National Mothers who were offering 'any' breast milk to their infants at 6-months (n = 39) by paternal socio-demographic characteristics [$]

Paternal socio-demographic characteristic	**Total sample of 401 mothers %**	**'Any' Breastfeeding at 6-months (n = 39) %**	**Non-breastfeeding mothers at 6-months (n = 362) %**	**Significance *p value***
Fathers' age group (yrs)	(n = 369)	(n = 38)	(n = 331)	
≤ 24	13	3	14	
25-34	59	50	60	
≥ 35	28	47	26	**0.006***
Fathers' education level	(n = 369)	(n = 38)	(n = 331)	
Primary & secondary	40	21	42	
Vocational/training course	31	24	32	
Third level degree/post-graduate	29	55	26	**0.001***
Paternal social class	(n = 369)	(n = 38)	(n = 331)	
Social Class 1	36	68	32	
Social Class 2	8	13	8	
Social Class 3	50	16	54	
Unknown category (unemployed/students)	5	3	6	**0.000****

* significant, $p<0.05$, ** $p<0.001$

[$] The univariate analysis compares the differences between the categorical variables, and those in the 'any' and non-breastfeeding groups at 6-months

Not all categories may add up to 100% as some values were rounded up or down

No significant differences were found between mothers' employment status at 6-months (full-time, part-time, not in employment) and 'any' breastfeeding at 6-months (*p=0.239*) (see **Table 5.15**). Similar proportions of mothers in the 'any' (23%) and non (20%) breastfeeding groups were in full-time employment at 6-months with a slightly higher proportion of breastfeeding compared to non-breastfeeding mothers reported to have 'not' been in employment at this time (69% versus 61% of mothers respectively). Although a greater proportion of mothers in the 'any' breastfeeding group returned to work >18 weeks post partum (67%) compared to those in the non-breastfeeding group (46%), this difference was not statistically significant (*p=0.296*).

Table 5.15. A description of the proportion of National Mothers who were offering 'any' breast milk to their infants at 6-months (n = 39) by maternal-related employment factors [$]

Maternal-related employment factors	**Total sample of 401 mothers %**	**'Any' Breastfeeding at 6-months (n = 39) %**	**Non-breastfeeding mothers at 6-months (n = 362) %**	**Significance *p value***
Mothers' employment status at 6-months post partum				
Part-time	18	8	19	
Full-time	20	23	20	
Mother not in employment	62	69	61	**0.239**
Timing of work return during the first 6-months post partum	(n = 152)	(n = 12)	(n = 140)	
≤ 18 weeks post birth	52	33	54	
> 18 weeks post birth	48	67	46	**0.296**

[$] The univariate analysis compares the differences between the categorical variables, and those in the 'any' and non-breastfeeding groups at 6-months

5.5 Discussion

The first part of this study (see **Chapter 4**) highlighted the particularly low breastfeeding initiation and duration rates among national mothers that warranted more specific and in-depth investigation. Similar to previous international (Grjibovski *et al.,* 2005; Kelly & Watt, 2005; Hendricks *et al.,* 2006) and regional Irish studies (Hurley & Fogarty, 1992; Ward *et al.,* 2004), socio-demographic variables were consistent predictive factors in determining breastfeeding initiation, and 'any' breastfeeding at 6-weeks and 6-months in the present study. Importantly, however, several modifiable determinants were also identified enabling their consideration and possible inclusion in future breastfeeding intervention studies and promotion campaigns.

Determinants of breastfeeding initiation and duration

Consistent with previous regional Irish research (Twomey *et al.,* 2000), our data highlight that primi-parous ($p=0.000$), married ($p=0.000$) mothers ≥ 35 years ($p=0.000$) in Social Class I ($p=0.000$) who had planned their pregnancy ($p=0.000$) were significantly more likely to have initiated breastfeeding, and to have been breastfeeding at 6-weeks. After adjustment in the binary logistic regression model however (see **Table 5.2**), only the effects of maternal age ≥ 35 years ($p=0.000$) and primi-parity ($p=0.000$) persisted. In contrast to other investigations (Bulk-Bunschoten *et al.,* 2001), maternal education was not identified as an independent determinant of initiation ($p=0.277$); however, mothers who had a third level education were almost 6 times more likely to have been breastfeeding at 6-weeks ($p=0.000$) compared to those who had a primary or secondary educational attainment level (see **Table 5.8**). Moreover, and in line with results by Lande *et al.,* (2003), almost three quarters of the mothers who were breastfeeding at 6-months (72%) had a third level education compared to significantly fewer non-breastfeeding mothers (27%) ($p=0.000$). These results suggest that older maternal age, compared to a higher education level, exerted a greater influence on initiation of breastfeeding, however, older and better educated mothers were more likely to continue the practice at 6-weeks and 6-months.

Multi-parous, compared to primi-parous mothers have been reported to breastfeed for longer duration (Salt *et al.,* 1994); however, our data demonstrate that primi-parous mothers were significantly more likely to initiate (OR 6.49, CI 2.45-17.15) and to have been breastfeeding at 6-weeks (OR 2.19, CI 1.06-4.52). It is possible that, because these mothers did not have to deal with extra demands from other children, this may have contributed to the greater prevalence of breastfeeding among this group. In support of existing literature (Meyerink & Marquis, 2002), the fact that mothers who 'ever' breastfed a previous child were more likely to initiate ($p=0.000$) and breastfeed for longer duration ($p=0.000$) in the present study increases the likelihood that these mothers may breastfeed their future children.

There is little doubt from our research that a positive ante natal intention to breastfeed predicts breastfeeding initiation and 'any' breastfeeding at 6-weeks, a finding that agrees with earlier studies (Chye *et al.,* 1997; Donath *et al.,* 2003). In particular, among the mothers who initiated breastfeeding, 94% had a positive ante natal intention to breastfeed compared to only 6% of the non-breastfeeding group ($p=0.000$). The inclusion of mothers' ante natal intention in the final binary regression models (see **Tables 5.4** and **5.9**) indicates that a positive ante natal intention to breastfeed is one of the strongest and persistent independent predictors of breastfeeding initiation ($p=0.000$) (93.8% predictive) and 'any' breastfeeding at 6-weeks ($p=0.000$). Despite the strength of the ante natal intention, the results also indicate that of these mothers, over half reported that they made the actual decision to breastfeed post birth ($p=0.000$). It is likely that mothers' ante natal feeding intention represented the intended 'aspirational' feeding method, however, the circumstances post birth (e.g. health status of mother and infant) determined the 'actual' feeding method. Furthermore, when mothers were contacted at the 6-week follow-up, it is possible that the interpretation of the question *'when did you make this infant feeding decision?'* was related to the point when mothers actually made the feeding decision i.e. post birth, rather than reporting that they had intended to breastfeed ante natally i.e. pre-pregnancy.

Based on the strong independent effect of the ante natal intention on breastfeeding initiation and duration from our data, it appears that in order to improve breastfeeding rates, the ante natal period should be targeted as being an effective time for the allocation of national resources. Application of this finding to the promotion of breastfeeding in Ireland emphasises the potential for dedicated time and an increased midwife: mother ratio during the ante natal clinics to modify mothers' beliefs, providing an ideal window of opportunity to educate parents on the benefits of breastfeeding. Exploring the concerns of parents who indicate ambivalence or resistance towards breastfeeding ante natally may be essential to addressing socio-cultural issues and misperceptions. Furthermore, early identification of maternal distress and concern related to breastfeeding issues during the ante natal period may represent a positive step to improve intended breastfeeding duration (Rondo & Souza, 2007). However, increased government investment is required to fund and employ specialized health professionals if these promotional initiatives are to be supported and implemented.

It is also noteworthy that the vast majority of mothers who initiated breastfeeding reported that breastfeeding was the most beneficial feeding mode for infants (96%) compared to only 45% of non-breastfeeding mothers ($p=0.000$), suggesting a possible deficit of information in the latter group (see **Table 5.10**). In line with these observations, Loh *et al.,* (1997) found that the maternal perception that breast and formula feeding provided similar health benefits to the infant (27.7%) was among the principal barriers to initiation. Similarly, Fennessy (1999) showed that the level of breastfeeding knowledge varied between formula and breastfeeding groups, with women who did not attend the ante natal classes being most unaware of the more specific health advantages of breastfeeding. It is also relevant that Chezem *et al.,* (2003) highlighted a strong correlation between maternal breastfeeding knowledge and confidence in breastfeeding (r = 0.262, *p=0.025*) along with actual lactation duration (r = 0.455, *p=0.0001*). The positive influence of maternal knowledge on the benefits of breastfeeding in the present study is further highlighted by the fact that these mothers were 20.91 times more likely to have been breastfeeding at 6-weeks (OR 20.91, CI 2.23-196.16, *p = 0.008*) suggesting that they may have been more aware of the benefits of breastfeeding beyond the initial few weeks post partum. Moreover, the health-related benefits of breastfeeding (54%) were among the central reasons reported by mothers in the breastfeeding group for choosing to initiate the practice (see **Table 5.6**) indicating that such motivations were foremost in their infant feeding decision. It has been suggested that health professionals are not effective in making known the advantages of breastfeeding (Lowry & Lillis, 1993). A simple statement such as ‘breast is best’ may not be an adequate impetus to entice mothers to breastfeed (Dermer, 1995). Efforts to increase ante natal class attendance with particular emphasis on the specific short and long-term benefits of breastfeeding among all mothers in Ireland may be crucial to improving rates.

Similar to findings by Lewallen *et al.,* (2006), books/mother-infant magazines (*p=0.000*) and the hospital midwives (*p=0.000*) featured as significant ante natal sources of infant feeding information and influences on breastfeeding initiation, associations that persisted in the final regression model (see **Table 5.5**). Support from health care providers has been shown to increase breastfeeding rates (Sharret-Stevens, 2007); however, shifting the balance between the provision of theoretical knowledge to more apprenticeship-style learning to mothers may also be important (Hoddinott & Pill, 1999). Motivational interviewing by the hospital midwives ante natally, aimed at decreasing maternal ambivalence and resistance toward sustained breastfeeding, has been shown to increase the number of days mothers actually breastfed post natally (Wilhelm *et al.*, 2006). It is thus possible that commitment to education and promotional programmes, once initiated during the ante natal period, could positively influence breastfeeding behaviour.

Furthermore, it appears from our data that hospital leaflets pertaining to breastfeeding were the only significant infant feeding information source associated with 'any' breastfeeding at 6-weeks (OR 1.98, $p = 0.037$). Following verbal advice by the midwife of the benefits of breastfeeding at mothers' first ante natal visit to the hospital, the routine provision of a breastfeeding information pack to mothers could be considered. GPs and PHNs in the health centres could also increase the availability of breastfeeding literature in their clinics. As the GP is often the first professional contact with pregnant mothers ante natally, the topic of breastfeeding and the provision of breastfeeding literature could be initiated during early pregnancy and discussed in a staged manner at each visit (Clarke *et al.,* 2002). Future breastfeeding intervention studies could consider the design and provision of user-friendly, multi-lingual breastfeeding information packs to parents and examine the impact of such information on breastfeeding rates pre- and post-intervention.

A compelling finding in this study was the significant and positive relationship between the encouragement from the partner and maternal grandmother to breastfeed on breastfeeding initiation ($p=0.000$) and duration ($p=0.000$) post partum. Regardless of the factors inputted into the regression models, encouragement from these key influences were identified as independent predictors of breastfeeding success, with a particular observation of the strong influence of the partners' ante, compared to post natal support. A wealth of evidence highlights the importance of social and emotional support from the partner (Ingram *et al.,* 2002; Li *et al.*, 2004; Okon, 2004), family members and friends in promoting breastfeeding initiation and duration (Ceriani Cernadas *et al.,* 2003; Kong & Lee, 2004). Encouragement of the partner and maternal grandmother to attend the ante natal classes and clinics may provide greater opportunity to strengthen and facilitate their positive influences on breastfeeding uptake. The provision of infant feeding information and guidance to the partner and the maternal grandmother during the ante and post natal period appears an appropriate measure in the promotion of breastfeeding, across all socio-economic groups. A partner-specific breastfeeding booklet entitled *'How to support your partner breastfeeding'* may increase the importance and exposure to breastfeeding information among the partners, which may in turn positively reinforce and encourage mothers to breastfeed.

Several studies have demonstrated a positive relationship between the occurrence of certain in-hospital practices on breastfeeding initiation (DiGirolamo *et al.,* 2001; Mikiel-Kostyra *et al.,* 2002; Forster & McLachlan, 2007), which help to create a positive and supportive breastfeeding environment for parents. Although published literature supports the positive associations between a normal vaginal delivery (Bartington *et al.,* 2006), non-receival of epidural (Wiklund *et al.,* 2007) or general (Bick *et al.,* 1998) analgesia during the birth, the occurrence of early skin-to-skin contact (Carfoot *et al.,* 2005; Moore *et al.,* 2007) and rooming-in (Pechlivani *et al.,* 2005) on breastfeeding initiation, our data demonstrates that no associations were observed between such in-hospital practices and either initiation or 'any' breastfeeding at 6-weeks.

In agreement with previous research indicating that work return was positively associated with initiation (Sayers *et al.,* 1995) and breastfeeding at 6-weeks (Ward *et al.,* 2004), this study also found that mothers who initiated, compared to those who did not initiate breastfeeding were significantly more likely to have ante natally expected to return to work ($p=0.000$), beyond > 18 weeks ($p=0.003$) post birth. Interestingly, no significant associations were observed between the breastfeeding and non-breastfeeding groups in terms of mothers' employment status at 6-months (*p=0.239*) indicating that a full or part-time employment status outside the home at 6-months may not contribute to the short breastfeeding duration rates among mothers in Ireland. The fact that the mothers who initiated breastfeeding had the ante natal perception that work return would influence the infant feeding pattern (*p=0.000*) post partum may suggest an element of 'being prepared' along with realistic considerations that breastfeeding may affect the work-life balance among these mothers post partum. It may be that the positive ante natal intention to breastfeed among those whom initiated breastfeeding included the realities of combining breastfeeding with work return, and these mothers were thus mentally and emotionally prepared for these practicalities post partum. Nonetheless, contrary to other studies (Chye *et al.,* 1997; Hawkins *et al.,* 2007), work return *per se* did not appear to be significantly associated with breastfeeding duration in the present study.

Crucially, this study highlights the important role of maternal attitudes and perceptions of the acceptability of breastfeeding in public in determining breastfeeding rates. Other investigators have reported similar findings (Zimmerman & Guttman, 2001; Scott *et al.,* 2006; Ladomenou *et al.,* 2007) indicating that maternal attitudes, compared to socio-demographic factors, are possibly better predictors of feeding choice (Scott *et al.,* 2004). The present study found that more positive attitudes to breastfeeding being 'natural' (*p=0.000*) and 'positive' (*p=0.000*) were associated with breastfeeding initiation and 'any' breastfeeding at 6-weeks with mothers who reported the practice as 'embarrassing' being almost 60% less likely (OR 0.43, *p = 0.000*) to initiate breastfeeding in the multivariate analysis with our results pointing towards the strong socio-cultural influence on both maternal attitudes and breastfeeding rates. Although national efforts to promote breastfeeding as a cultural norm continue *via* media campaigns, increased breastfeeding education in schools and restrictions on infant formula advertising and marketing, results from the present study highlight the perception among many mothers that breastfeeding is a social taboo and an embarrassing way to feed an infant. These data are further supported by mothers' principal reasons for choosing not to breastfeed, with the 'embarrassment issue' being a priority among almost a third of these mothers (31%) (see **Table 5.7**). The perception and feeling among mothers that breastfeeding is 'embarrassing' or 'shameful' has been suggested as a barrier to initiation and duration by other investigators (Matthews *et al.,* 1998; Shepherd *et al.,* 2000). However, barriers, including the perception that breastfeeding is not an appealing way to feed an infant (Sloan *et al.,* 2006), lack of knowledge of breastfeeding management (Hogan, 2001) and society's negative attitudes towards breastfeeding (McFadden & Toole, 2006) have also been documented.

It is likely that maternal attitudes to infant feeding are closely associated with cultural perceptions as to what defines the normal feeding mode for infants. Moreover, Ergenekon-Ozelci *et al.,* (2006) surmised that cultural beliefs have a significant influence on breastfeeding practices. In support of the possible attitude that breastfeeding is still viewed as an embarrassing practice in Ireland, a previous cross-sectional regional Irish study examining the attitudes of young men (n=115) and women (n=62) (age range 16-19 yrs) found that 'embarrassment and discomfort' were the predominant emotions expressed around the subject of breastfeeding, with the majority of participants reporting that they disapproved of breastfeeding in public (Connolly *et al.,* 1998). The aforementioned study provided further insight, indicating that visual exposure to the naked breast, accompanied by confusion around the dual feeding/sexual role of the female breast seemed to be the source of this embarrassment. In contrast, a prominent author from Norway, a country with one of the highest breastfeeding rates in Europe, remarked that *'breastfeeding is so normal; it's more embarrassing to bring out the formula feeding bottle in public'* (Jacobson Lepri, 1998). It appears that efforts to reenergize a breastfeeding culture in Ireland, greater efforts need to focus on normalizing the practice from early childcare and primary school. Optimistically, breastfeeding educational programmes and interventions have been shown to effectively improve breastfeeding attitudes and beliefs among adolescents (Martens, 2001).

The finding that almost a quarter of mothers reported that they chose not to breastfeed owing to the lifestyle and time restrictions associated with the practice (24%) may reflect the changing role and expectations of mothers in our society. However, it is possible that a more accepting and supportive breastfeeding culture in Ireland and more positive attitudes among mothers to breastfeed, could over-ride their perceptions of breastfeeding being 'too demanding' and 'restrictive'. It has been suggested that formula feeding may represent a symbol of women's liberation, which may strongly influence women's choices, and that breastfeeding may be contrary to the feeding method of the modern mother (Kim, 1998).

It also appears from our data that low self-efficacy levels existed among the non-breastfeeding group, which may indicate a less overt reason for mothers choosing not to initiate breastfeeding. Although only 6% of mothers reported a lack of confidence in being able to breastfeed (see **Table 5.7**) as a principal reason for not initiating, it is highly relevant that in a separate and specific examination of mothers' self-efficacy levels, 67.5% reported that they would 'not have been confident' or 'not at all confident' in their ability to breastfeed. Thus although the issue of embarrassment featured as a strong barrier to initiation, the possibility that these mothers, had they initiated, lacked the confidence to correctly and successfully master the skill of breastfeeding may feature as an underlying reason for our low initiation rates in Ireland. Low maternal self esteem and lack of confidence in being able to breastfeed effectively have been suggested as barriers to breastfeeding initiation (Dykes *et al.,* 2003) and duration (Semenic *et al.,* 2008) by other investigators. In addressing the possible confidence deficits among some mothers, future public health campaigns could emphasise that it is possible for all mothers to breastfeed, regardless of their previous feeding experiences, once adequately supported.

To further compound the complexity of these issues, it appears that non-breastfeeding mothers had significantly less exposure to the maternal grandmother ($p=0.016$), sister ($p=0.000$) and friends ($p=0.000$) breastfeeding. Almost identical observations have been reported by Fitzpatrick *et al.,* (1994). Increasing breastfeeding rates among mothers who have only been exposed to a formula feeding family tradition and culture is clearly indicative of the public health challenge in Ireland. In order to entice these mothers to breastfeed, modifying such inter-generational familial traditions will be necessary, with the crucial implementation of community support structures to support continued breastfeeding post hospital discharge.

Consistent with previous research highlighting the PHN as an important source of support for mothers post partum (Bourgoin *et al.,* 1997; Kuan *et al.,* 1999), mothers in the present study who reported to have had >2 (62.2%), compared to 1-2 PHN home-visits were significantly more likely to have been breastfeeding at 6-weeks ($p=0.016$). According to a descriptive study (n=379) by Lewallen *et al.,* (2006), almost all women received practical help with breastfeeding in the hospital (92%); however, only 51% received help with breastfeeding after returning home. It thus appears that the PHN is in a unique position to effect change. Increased face-to-face contact with the PHN post partum may help to build rapport and facilitate opportunities to support breastfeeding mothers, which may in turn encourage continuation of the practice. However, it is also possible that if mothers receive greater support from family and friends, particularly from those who could advise mothers on the practicalities of breastfeeding, there would be less need for PHN input.

Factors affecting premature discontinuation of breastfeeding during the first 6-months

A higher prevalence of mothers reported to having abandoned breastfeeding during the first 6-weeks owing to maternal tiredness in the present study (26%), compared with previous regional Irish research (18.5%) by Howell *et al.,* (1996). According to Ward *et al.,* (2004) the central reasons for discontinuing breastfeeding prior to 6-weeks were related to mothers perceiving the infants to be 'hungry' or 'unhappy'; however, maternal issues pertaining to the need for a routine feeding regimen were more commonly reported at 14-weeks. Discontinuation owing to breastfeeding-related physical reasons (e.g. cracked/sore/bleeding nipples) between 1-4 weeks and > 4 weeks post partum have been reported by investigators in the USA (Ahluwalia *et al.,* 2005). Reasons related to work return (Earland *et al.,* 1997), the maternal perception of the insufficiency of her breast milk supply (Chen & Chi, 2003) and experiences with breastfeeding problems (McLeod *et al.,* 2002) have also been suggested as major barriers to continuation. Interestingly, findings from the present study indicate that maternal-related reasons were central to the reported reasons for breastfeeding cessation during the first 6-weeks (maternal tiredness: 26%), as well as between 6-weeks and 6-months (demands/restrictions associated with breastfeeding: 39%). Taken together, these data suggest that breastfeeding cessation during the first 6-months was strongly related to mothers own personal choice and preference, and was possibly independent of other external factors. Future research could explore the effectiveness of maternal assistance in the form of a home helper with dedicated time to household chores, on breastfeeding duration.

In relation to the premature cessation of breastfeeding, the possibility that the modern mother is 'trying to do it all', balancing the emotions and practicalities of motherhood with being a wife, as well as having to deal with her own high internal expectations must be considered. Moreover, it has been shown that higher maternal relationship distress with the partner was predictive of early breastfeeding cessation among an ethnically diverse group of upper middle-class women (n=115) in the USA (Sullivan *et al.,* 2004). Including the possible impact of breastfeeding on relationship quality, along with a realistic portrayal of the physical and emotional demands of breastfeeding ante natally, may prepare parents for the practicalities that lie ahead.

In agreement with previous observations (Hurley & Fogarty, 1992), infant or maternal illness, physical problems related to breastfeeding such as mastitis, and the perception that 'the infant was not a natural breast-feeder' did not feature as prominent reasons for discontinuing breastfeeding during the first 6-weeks nor between 6-weeks and 6-months post partum in the present study. Although 'work return' appeared an important reason for discontinuing breastfeeding among 30% of mothers in previous regional Irish research (Lowry & Lillis, 1993), our data suggest that work return contributed negligibly to discontinuation during the first 6-weeks (1%), while it was reported as a reason for discontinuation between 6-weeks and 6-months by 12% of mothers. Our research thus indicates that work return and the length of maternity leave in Ireland (statutory maternity leave: 26 weeks) may not explain the short breastfeeding duration rates.

Overall, it appears that greater emotional and professional support to mothers will be necessary if increased national breastfeeding duration rates are to be achieved. A specific focus on reassuring mothers of the adequacy of their breast milk in satisfying their infants' hunger is suggested as an important strategy to supporting breastfeeding continuation post partum. Undoubtedly, persistent national efforts are required to promote breastfeeding as being the 'normal method' of feeding for infants, however, more powerful messages to entice mothers to continue breastfeeding need to be considered to address maternal-related perceptions that the practice limits and restricts their lives.

5.6 Conclusions

To address the inequalities of health in Ireland, and worldwide, the promotion of breastfeeding is of major importance (James *et al.,* 1997). This study sought to investigate the factors related to a mother's decision to initiate breastfeeding and continue the practice until 6-months post partum. As illustrated in **Figures 5.1** and **5.2**, the independent factors that were found to predict breastfeeding initiation and duration in the present study are multi-factorial in nature and underscore the complex interplay of factors influencing breastfeeding. Firstly, there is still a need for effective strategies which support and encourage breastfeeding among younger and less educated mothers in Ireland. Although considerable variation in breastfeeding rates can be attributed to socio-economic factors, the present study highlighted the existence of a number of potentially modifiable determinants, which could be considered in future breastfeeding promotion campaigns.

Of major significance, results suggest that public health efforts to promote breastfeeding should focus on the ante natal period when a mother's infant feeding intention is subject to change. Developing creative and effective breastfeeding ante natal educational programmes for parents is strongly suggested as one of the most important measures to improve breastfeeding rates in Ireland. Emphasising the specific nutritional and immunological benefits unique to breast milk, as well as instilling in mothers that it is possible for the majority of mothers to breastfeed, appear crucial to these promotion efforts. Regardless of socio-economic status, the inclusion of the partner both ante and post natally is strongly supported by this research, indicating that their positive influence on breastfeeding success is paramount to the initiation and continuation of the practice.

Other dominant themes that emerged from this research were related to the importance of the hospital midwives, PHN, infant feeding literature, the maternal grandmother and sister in positively influencing breastfeeding rates, emphasising their role in future breastfeeding promotional strategies.

Finally, the current findings are certainly an indictment of population attitudes and support towards breastfeeding with the identification of a marked maternal perception of breastfeeding not being the 'default feeding method' rather than the first choice and most natural feeding method for infants. The cultural barrier towards breastfeeding appears to still prevail among mothers in Ireland. Clearly, a significant shift in thinking among formula feeding mothers is needed if rates are to improve. To support the development of breastfeeding as the cultural norm, future interventions targeting breastfeeding outcomes should consider social status and cultural factors, as greater emphasis on the social acceptability of feeding appears increasingly important. Above all, advice to parents should emphasise that breastfeeding is a relatively short-term commitment that confers a worthwhile long-term health investment to both the infant (Gillman, 2002; Singhal *et al.,* 2004) and mother (Heinig & Dewey, 1997).

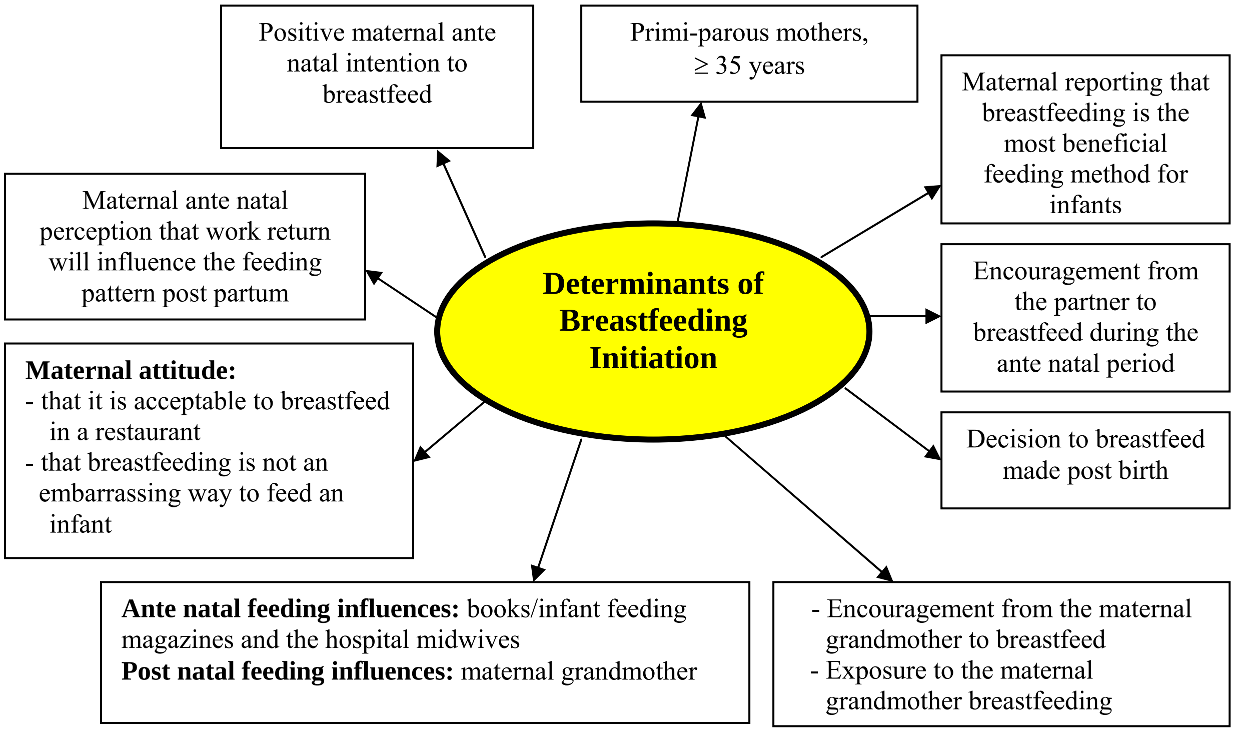


Figure 5.1. Independent determinants of breastfeeding initiation identified in the present study

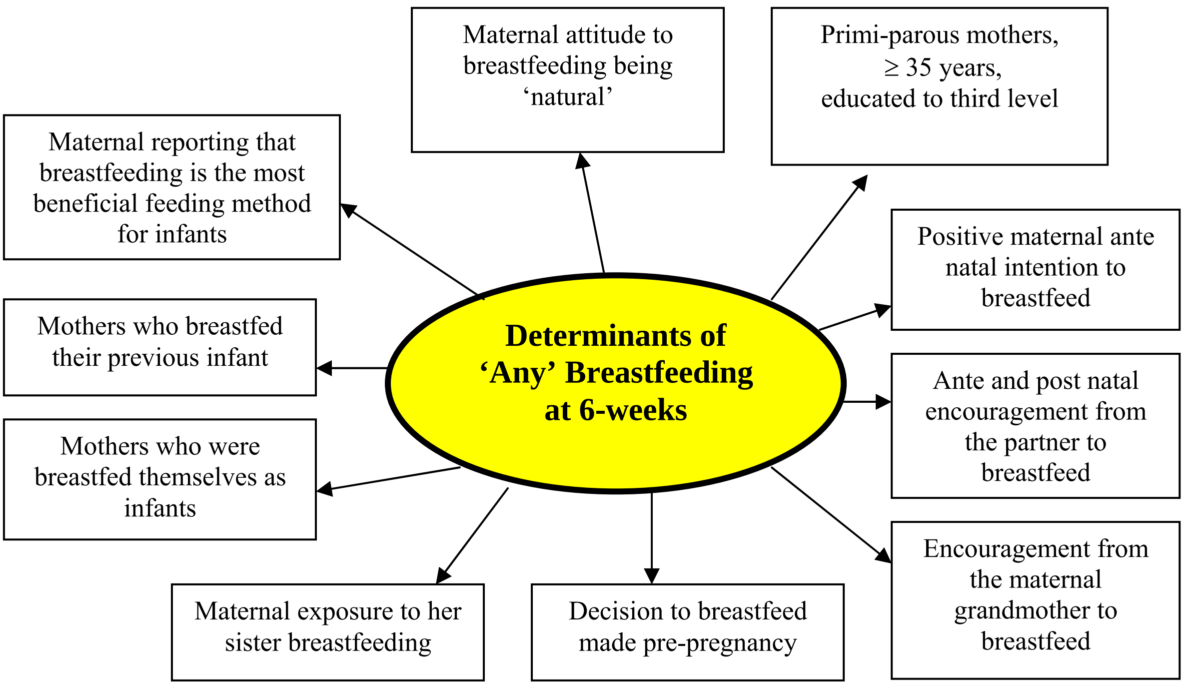


Figure 5.2. Independent determinants of 'any' breastfeeding at 6-weeks identified in the present study

Chapter 6

Weaning Practices in a Sample of Healthy Term Infants

CHAPTER INDEX **PAGE**

6.1 Introduction

During the first two years of life, eating patterns progress dramatically from a complete reliance on breast or formula milk as the sole source of nutrition to a varied diet based around family foods. These transitions are mediated by a number of developmental milestones and feeding transitions. The gradual introduction of foods other than breast or formula milk, known as the 'weaning process', is essential to meet the infants' increasing nutritional requirements from 6 months post partum (Department of Health UK, 1994). The WHO (2001) recommends exclusive breastfeeding for all infants during the first 6 months of life, with the introduction of solid foods at six months along with continued breastfeeding until 2 years. However, international and national research reports that the majority of infants are weaned by 6-months (Foster *et al.,* 1997; Savage et *al.,* 1998; Freeman *et al.,* 2000; Twomey *et al.,* 2000; Hornell *et al.,* 2001; Donath & Amir, 2005). This unfavourable practice may have adverse health implications for these infants in terms of increased allergy (Chandra, 2000) and eczema (Forsyth *et al.,* 1993; Tarini *et al.,* 2006) risk as well as the vulnerability of the gut to infection (Popkin *et al.,* 1990). In addition, the infants sucking mechanism, which is designed to transfer food from the back of the tongue is not developed until 4-6 months of age (AAP, 1980). Novel research examining the associations between early infant feeding practices and the development of Type I Diabetes concluded that exposure to dietary gluten before 3 months, compared to after 3 months, resulted in a 5-fold higher risk for the development of Type 1 Diabetes-associated autoantibodies (Ziegler *et al.,* 2003). Of further clinical importance, Wright *et al.,* (2004) confirmed that infants weaned before 3 months were significantly more likely to suffer minor morbidity such as diarrhoea and were marginally more likely to have seen their GP between 6 weeks and 4 months compared to infants weaned after 4 months.

Increasing evidence suggests that early dietary patterns and feeding behaviour determine childhood feeding habits and food preferences (Harris, 1993; Devine *et al.,* 1999; Skinner *et al.,* 2002b). Furthermore, early infant feeding practices have been implicated in the development of childhood overweight and obesity (Serdula *et al.,* 1993; Wilson *et al.,* 1998; Stettler *et al.,* 2002; Ong *et al.,* 2006). Undoubtedly, food consumption habits and feeding patterns during infancy present an environmental determinant of later overweight and obesity risk (Baughcum *et al.,* 1998).

Health professionals are witnessing a higher prevalence of overweight infants and toddlers in clinics than observed in former decades (Nader *et al.,* 2006). Childhood obesity and an increasing incidence of childhood Type II Diabetes Mellitis (Haines *et al.,* 2007) present a huge challenge for our current medical system (Sturm, 2002), with marked psychological and deleterious health consequences for these children (Daniels *et al.,* 2005). Diet-related risk factors for the development of obesity have been identified in children including high sugar sweetened beverage consumption (Ochoa *et al.,* 2007), high early energy intake and lack of breastfeeding (Moreno & Rodriquez, 2007) and snacking behaviours (Takahashie *et al.,* 1999). It is also established that childhood obesity increases the risks of obesity during adulthood (Serdula *et al.,* 1993; Guo *et al.,* 1994). The growing economic impact of obesity is also a concern (Wang & Dietz, 2002). While on-going public health efforts strive to halt, or slow the progression of this chronic disease, a comprehensive investigation and documentation of the diet during early infancy may improve our understanding of early dietary patterns that may influence later food preferences.

6.1.1 Weaning and implications for later life

The importance of weaning and its consequences during later life cannot be underestimated. Research examining food preferences have identified a link between early exposure to certain foods and subsequent food acceptance. It has been shown that 2-7 year olds were more willing to sample new foods if they had previously been offered a greater diversity of foods (Pelchat & Pliner, 1986). Furthermore, food preferences at ages 2 and 4 years old have been shown to be major predictors of later food preferences at 8 years of age (Skinner *et al.*, 2002b). Recent research suggests that the foundations for lifelong dietary habits are formed early in life (Kay-Fox *et al.,* 2006). Children, who from the earliest age have plentiful opportunities to sample a variety of healthy foods, appear to have healthier diets throughout childhood (Cooke, 2007). The implications of the dietary patterns established during weaning on later child and adult health must also be considered. Adult diseases related to obesity are now becoming more prevalent among the young (Sinha *et al.,* 2002; Berenson, 2005; Marcovecchio *et al.,* 2005). The diet consumed during childhood has been demonstrated as a significant determinant of adult diet even after 21 years (Mikkila *et al.,* 2004). It has been suggested that modifying the diet during infancy and early childhood could modify the expression of chronic diseases (Kleinman, 2000).

6.1.2 Current weaning trends

Changing parental lifestyles, familial influences, greater availability of commercially-prepared infant foods, increased information to mothers of best weaning practices and an improved community health service are among some of the many influences of current weaning trends. Exploration and documentation of these changing patterns of feeding behaviour deserve greater attention. There is a currently a lack of information on the general weaning patterns of our 61,076 population of infants (< 1 year old) in Ireland (CSO, 2006 figures). Furthermore, the extent to which mothers adhere to weaning recommendations is not known.

6.1.3 Timing of introduction to solid foods

While the optimal age for the introduction of solids has been much debated, all expert groups agree that 4-months/17 weeks should be the earliest time for the introduction of solids to all infants (Department of Health UK, 1994; FSAI, 1999). Despite these weaning recommendations, early weaning (<12 weeks) remains a commonplace practice among mothers (Foster *et al.,* 1997). Previous Irish-based research highlighted that 68% of infants had been weaned onto solids by 3 months (Freeman, 1996). In view of the fact that the timing of the first introduction of solids has been shown to be a potentially important factor for subsequent health (Wilson *et al.,* 1998), it is essential to research and report on the proportion of infants weaned onto solids during the first 6-months of life, including the reasons for such weaning decisions.

6.1.4 First weaning foods

Dietary options and first food choices offered to infants during the weaning period are determined by cultural, religious, ethnic, climatic and geographical factors. In the Mediterranean countries (e.g. Italy, Greece, Spain) fruit puree has been shown to be the most prevalent first food offered to infants (Giovannini *et al.,* 2004), whereas cereal based first foods were most commonly offered to infants in the northerly countries such as Sweden and the UK (Sarwar, 2002).

6.1.5 Home-prepared versus commercial baby foods

Both home-prepared and manufactured infant age-specific weaning foods are suitable weaning choices (Thomas & Bishop, 2007). However, it is important to expose infants to a mixture of food preparations to avoid any food or consistency aversions, or the development of a strong preference toward a particular food preparation. The composition of home-prepared baby foods varies considerably and can be nutritionally inadequate (Morgan *et al.,* 1995; Wharton, 1997; Sritharan & Morgan, 2003), containing relatively low levels of protein, energy, iron, calcium, zinc and high levels of sodium and non-starch polysaccharides (Stordy *et al.,* 1995). It has been suggested that mothers may avoid feeding infants home-prepared foods owing to their lack of confidence in modifying family foods and an uncertainty with regard to the suitability of family foods for infants (Sarwar, 2002).

After breast or formula milk, commercial baby cereals have been identified as significant contributors of energy (6.5% of total energy), protein (6.8% of total energy) and carbohydrate (9% of total energy) in the diets of 6-11 month olds while commercial baby food dinners were identified as the principal contributor to their dietary fibre intakes (Kay-Fox *et al.,* 2006). An assessment of the diets of 7-8 month olds demonstrated that meat is more commonly consumed in commercial baby food dinners than home-prepared meals (Kay-Fox *et al.,* 2004). Research examining infant dietary patterns (Wright *et al.,* 2004) found that 92% of infants were consuming commercially-prepared foods as first weaning foods. Briefel *et al.*, (2004a) demonstrated that a significant proportion of infants consumed commercial baby foods between 4-6 months (73%) and 7-8 months (95%).

6.1.6 Inappropriate weaning practices and current patterns

Inappropriate weaning practices (see **Table 1.5**) are those that are deemed unfavourable to the infant in terms of health, safety, growth and development, both for the long and short term. Previous studies assessing the nutrient adequacy of infant diets alert us to the possibility that some infants may be consuming excessive energy intakes as early as 6-months. Devenay *et al.*, (2004) reported that the mean energy intake exceeded the estimated energy requirements by 10% for infants 4 to 6 months, and 23% for infants 7-12 months. Of further significance, the discrepancy between mean energy intake and the estimated energy requirement for infants 4-6 months was larger for infants fed solids than for infants who were exclusively breast or formula fed. Moreover, a descriptive analysis carried out by Kay-Fox *et al.*, (2004) documented the weaning foods and beverages consumed by over 3,000 4-24 month old infants in the USA, concluding that infants as young as 7 months of age showed food patterns that have been observed in older children and adults. Almost half of the infants assessed (46%) between 7-8 months consumed some type of dessert, sweet or sweetened beverages while an appreciable proportion of infants (17%) were consuming non-infant specific ready to eat cereals, crackers and crisps.

6.1.7 Community health professional support for mothers in Dublin

All mothers in Ireland, subsequent to discharge from the maternity hospital, must be followed up within 48-hours by a PHN *via* a home visit. In addition to PHN input, 'high risk' mothers such as younger, vulnerable and those lacking confidence in their abilities to feed and care for their infants are referred to the '*community mothers' scheme'*. This scheme involves regular home visits and the support of an experienced non health professional community mother. First time and breastfeeding mothers are given particular attention in the community owing to their increased need for support.

During the infant's first developmental check-up at 3-months, the PHN verbally informs mothers of best weaning practices. Information, in particular, refers to the recommended timing of introduction to solids for both formula and breast fed infants. In addition, mothers are given one of two existing public health weaning leaflets 1.) '*Spoon feeding your baby'* or 2.) '*First foods for infants'*. **Appendix XII** provides an overview of the community care pathway from birth through the first year of life.

6.1.8 Methodologies to collect weaning data

Previous infant feeding studies examining weaning practices have used the 24-hour recall method (Kay-Fox *et al.,* 2006), 3-day weighed food records (North *et al.,* 2000), food frequency questionnaires (Freeman *et al.,* 2000) or a combination of all methods (Wharf *et al.,* 1997) to document feeding practices. The most commonly used methods in paediatric research include a maternal 24-hour recall of their infant's previous 24-hour intake or 'usual intake'. A maternal (or other primary caregiver) 24-hour dietary recall based on an infant's intake on the 'previous day' (Skinner *et al.*, 2004) of an interview however, may not be fully representative of an infant's usual diet owing to a change in infant mood on that particular day or a change in environment that interfered with the infant's appetite. Methodologically, some infant feeding studies have consistently and specifically recorded maternal recall (Northstone *et al.,* 2001; Sarwar *et al.,* 2002) of their infants' diets, while others have stipulated the 'carer' (Freeman *et al.,* 1998) or 'parent or primary caregiver' (Briefel *et al.,* 2004a) as the individuals required to record the diet history.

Regardless of the dietary collection method, there is some evidence to suggest that there is less day-to-day variation in dietary intake among infants than among older children and adults (Wharf *et al.,* 1997; Lanigan *et al.,* 2004). Sanjur *et al.,* (1994) demonstrated that a maternal 24-hour dietary recall provides mean dietary intakes for most nutrients comparable to both 2-day and 7-day food records. Furthermore, a study specifically assessing the precision of the maternal 24-hour dietary recall found that the method provides unbiased estimates of infant dietary intakes, proving a valuable tool for dietary surveys (Dop *et al*., 1994).

6.2 Aims and objectives

The aims of this study were to investigate and document the weaning practices of a sample of mothers in Dublin during the first 6 months post partum and assess compliance with current weaning recommendations. The specific objectives were to:

- ✓ Describe the feeding status of infants at 6-months including a clear outline of daily meal, snack and dessert patterns
- ✓ Quantitatively document snack types and snacking patterns of infants including the weekly snacking frequency
- ✓ Quantitatively document the supplementary fluids consumed by infants including the daily volume of fluids consumed
- ✓ Report on the timing of introduction to solid foods
- ✓ Describe the types of food offered to infants at 6-months including first foods, breakfast, lunch, evening meal and dessert foods
- ✓ Explore the usual consumption frequency of home-prepared and commercially-prepared weaning foods
- ✓ Examine the prevalence of inappropriate weaning practices including additions of solids to infant feeds and the additions of unsuitable additions to weaning foods
- ✓ Compare the weaning practices between mothers who were breastfeeding and formula feeding at 6-months

6.3 Methodology

The study design, sample selection and recruitment, and an explanation of the study sample are described in **Chapters 2** and **3** respectively. Of the eligible 520-mother/infant pairs followed-up at 6-months, 401 of these were national mothers, on which the weaning practices for this chapter are based. Whether mothers were interviewed *via* telephone or a home visit, the researcher ensured consistent and standard interviewing styles. The home visits did not involve the presentation or observation of the usual baby foods offered to infants, such as commercial baby food jars. Details of the 6-month follow up protocol are documented in **Section 2.8.**

6.3.1 Conduct of dietary assessments

All dietary assessments were conducted by one investigator, thus, minimizing within-observer variation and promoting standardisation of methods across the study population. Prior to commencing the study, the investigator trained and worked in clinical paediatrics and was experienced in taking and evaluating maternal recalls of infant diet histories.

Every effort was made to avoid prompting mothers to report socially acceptable responses. The researcher avoided expressing any verbal or facial reaction to mothers who may have adopted unsuitable feeding practices. In accordance with ethical approval, mothers who were conducting inappropriate weaning practices were advised to discuss the issues of concern with their local public health nurse, who was informed of the case by the investigator. It was made clear to mothers that if they had specific questions regarding best weaning practices or questions pertaining to how they fed their infants, these questions would be addressed upon completion of the interview.

6.3.2 Dietary assessments

Qualitative and quantitative weaning data were collected *via* a maternal '24-hour recall' of the infant's usual diet (see **Appendix X)**. Solid foods or solids were defined as any food offered to the infant other than breast milk, formula or other milks such as cow's milk. Meal types were defined by the time of the day the particular meal was consumed. Daily meal frequencies were specifically differentiated as a:

1.) **Breakfast**: morning meal event consumed from time of waking till mid-day

2.) **Lunch**: mid-day meal event; may usually be consumed from 12pm till 3pm

3.) **Evening meal**: evening meal event; may usually be consumed from 3-6pm

4.) **Late 'supper'**: meal event consumed after 6pm or pre-bedtime

These main meal events were described to mothers as the 'set routine meals regularly offered to infants on a usual day'. A late evening 'supper' was created as another meal category, which denoted any routine meal event consumed in the late evening (a later meal event to the evening meal). Some dietary assessments required the use of the 'supper' category, particularly when infants consumed three main meals, a dessert as well as more than one snack on a usual day.

Food categories for all meals specified whether home-prepared meals were **'modified'** or **'unmodified'.** Modified home-prepared meals were specifically prepared for infants, conducive to healthy eating guidelines and cooked without the use of added condiments such as gravy, salt or sauces. Unmodified meals were those that included the latter unsuitable additions and were served as meals to the family, as well as to the infant. **'A dessert'** was defined as a separate meal episode to the usual daily meal frequencies as described above, defined as 'a sweet or savoury meal provided after the main meal'. It was not recorded whether the dessert was consumed subsequent to the mid-day or evening meal. In addition, fluids offered to infants other than breast or formula milk were defined as **'supplementary fluids'** such as water, cow's milk, ordinary juices or baby juices. As infant feeding recommendations (AAP, 2001; Allen & Myers, 2006) advise that '120-180mls of fruit juice per day is more than adequate for infants' and should be limited to 180mls per day, the daily volumes of supplementary fluids in this study were quantified as being consumed in volumes ' < 180mls' or '≥ 180mls' daily. As cooled boiled water is a recommended and suitable supplementary fluid for infants who are not exclusively breastfed < 6-months (Department of Health UK, 1994, FSAI, 1999), this study particularly sought to examine the volume of supplementary fluids consumed, other than cooled boiled water, including baby juices, ordinary juices, carbonated drinks, tea, cow's milk as well as home-prepared mixtures of sugar and water.

Following the 24-hour recall of the infant's usual diet, mothers were questioned on their infants' snacking pattern *via* a food frequency questionnaire format. **'Snacks'**, regardless of size, composition or usual consumption time per snack, were defined as any food (sweet and/or savoury) offered to infants in-between the routine meals described above, either on a regular or irregular basis. Information was collected on daily meal and dessert frequencies as well as weekly snacking consumption patterns including the type and frequency of snacks usually consumed weekly. The dietary assessment did not record quantitative information pertaining to meal or snack portions, however, daily type and specific volumes of supplementary fluids offered to infants were documented.

Specific information on the type and brand of foods and fluids consumed was elicited. For instance, it was ascertained whether cow's milk was whole, semi-skimmed or skimmed and whether the yoghurts were baby-specific yoghurts or ordinary yoghurts. Mothers were questioned on the type of juices provided to infants such as jars of commercially-prepared baby juice or ordinary fruit juice. In addition, it was established whether the home-prepared meals offered to infants were modified (baby-specific) or unmodified. Following completion of the dietary assessments, the researcher consistently re-called the information back to mothers to ensure the correct understanding and interpretation of the initial dietary re-call.

Rather than using an infant feeding or diet-specific coded database, the database was manually coded according to the foods inputted. For the purpose of improved data interpretation, general food categories were avoided e.g. if mothers reported that the infant usually consumed '*Milupa Sunshine Orange baby cereal'* for breakfast, then 'Milupa Sunshine Orange Cereal' category was used rather than creating a 'commercial baby cereal' category. If mothers did not volunteer the specific brand and type of commercial baby food offered to the infant, then the food was categorized generally, for example 'commercial jar of meat and vegetable' or 'commercial jar of stewed apple'. The specific detailed food categories were created for snack food options (see **Appendix XIII**), first foods (see **Appendix XIV**), breakfast (see **Appendix XV**), lunch (see **Appendix XVI**), evening meal (see **Appendix XVII**) and dessert (see **Appendix XVIII**) food categories**.** For the purpose of results and ease of interpretation, these foods were then further categorized and consolidated into generic categories.

6.3.3 Timing of weaning

For standardisation purposes in this thesis, four weeks was taken to be one month. It was always clarified whether mothers' understanding of 4 months was equivalent to 16 weeks or 17 'calendar' weeks. The week in which weaning was initiated was then allocated to the appropriate weaning period such as birth to 4-weeks, 4.1-6 week, 6.1-8 weeks, 8.1-12 weeks, 12.1-16 weeks, 16.1-20 weeks and >20 weeks.

While the infant's feeding status at 6-months was documented, information was collected on the feeding status during the intervening periods (8, 12, 16 and 20 weeks) between 6-weeks and 6-months.

6.3.4 Statistical analysis

SPSS Version 13.0 was used to analyse the data, which are summarized numerically using mean ± standard deviation or median (interquartile range for skewed non-normal data). The relationship between categorical data were analysed using cross tabulation of the Chi-Squared test. Statistical significance was taken at $P < 0.05$. For cross tabulations involving two dichotomous variables, the Yates's continuity correction value was used. When comparing the mean values for continuous variables between groups, the data were initially assessed for normality of distribution and the Independent-Samples *t-test* (normally-distributed data) and the Mann-Whitney *U* Test (skewed data) used as appropriate.

6.4 Results

The mean time of the 6-month follow-up of mother/infant pairs (n = 401) was 24.73 wks ± SD 0.43 wks (minimum-maximum 24-26 wks). The majority of mother/infant pairs were followed up *via* a telephone interview (76%; n = 304) while a home visit was conducted in 24% of cases (n = 97). The characteristics of the 401 mothers and infants are outlined in **Chapter 3**.

6.4.1 6-month feeding status

Table 6.1 outlines the feeding status of the infants at 6-months (n = 401). The majority of infants were consuming infant formula with solid foods (n = 361). Only one infant from the sample was exclusively breastfed (<1%) at 6-months. In total, 38 infants (9%) were partially breastfed, with 13 of these infants consuming breast milk and solids, and 25 infants consuming breast and formula milk combined with solids. One infant was consuming cow’s milk with solid foods (<1%) in the absence of vitamin/mineral supplementation.

Table 6.1. Feeding status of infants born to National Mothers at 6-months (n=401)

Feeding status	% of infants (n)
Exclusively breastfed	0.2 (1)
Partially breastfed: Breastfed with solid food	3.2 (13)
Partially breastfed: Breastfed with formula milk and solid food	6.2 (25)
Formula fed with solid food	90 (361)
Full fat cow’s milk with solid food	0.2 (1)

Fluids consumed at 6-months

Table 6.2 shows the proportion of infants consuming various types of milk and supplementary fluids at 6 months. The majority of infants were consuming infant formula milk (96%) with casein-based and follow-on formula being the most frequently consumed formula type by 146, and 111, infants respectively. Few infants (n = 21) were consuming a specialized infant formula specific to a medical condition for example, lactose intolerance (lactose free formula), cow's milk protein intolerance (extensively hydrolysed infant formula) and gastro-oesophageal reflux (pre-thickened infant formula). The mean number of formula feeds consumed daily (n = 386) was 4.09 ± 0.99 formula feeds (min-max 1-7) with 205mls ± SD 37.45 (min-max 90-300mls) reported as the mean formula volume per feed. The mean daily formula volume consumed was 828mls ± SD 226mls (min-max 90-1480mls). Almost 10% of infants (n = 39) were receiving 'any' breast milk. The mean number of breastfeeds provided to infants was reported as 4.2 ± 2.2 breastfeeds (min-max 1-9).

In total, 82% of infants (n = 329) were consuming supplementary fluids. Cooled boiled water was the most commonly consumed fluid by 45% of infants (n = 180), while 3.7% of (n = 15) were consuming water with added condiments such as sugar, glucose or honey. Commercially-prepared baby juices were prevalent in the diet of almost half of the population (47%), with 140 infants receiving commercially-prepared bottled baby juice and 47 infants receiving diluted baby juice. Ordinary fruit juices such as orange, prune and carrot juices were consumed by 2.9% of infants. Tea (n = 4) and carbonated drinks such as cola and diet 7-Up (n = 5) were consumed by over 2% of the population.

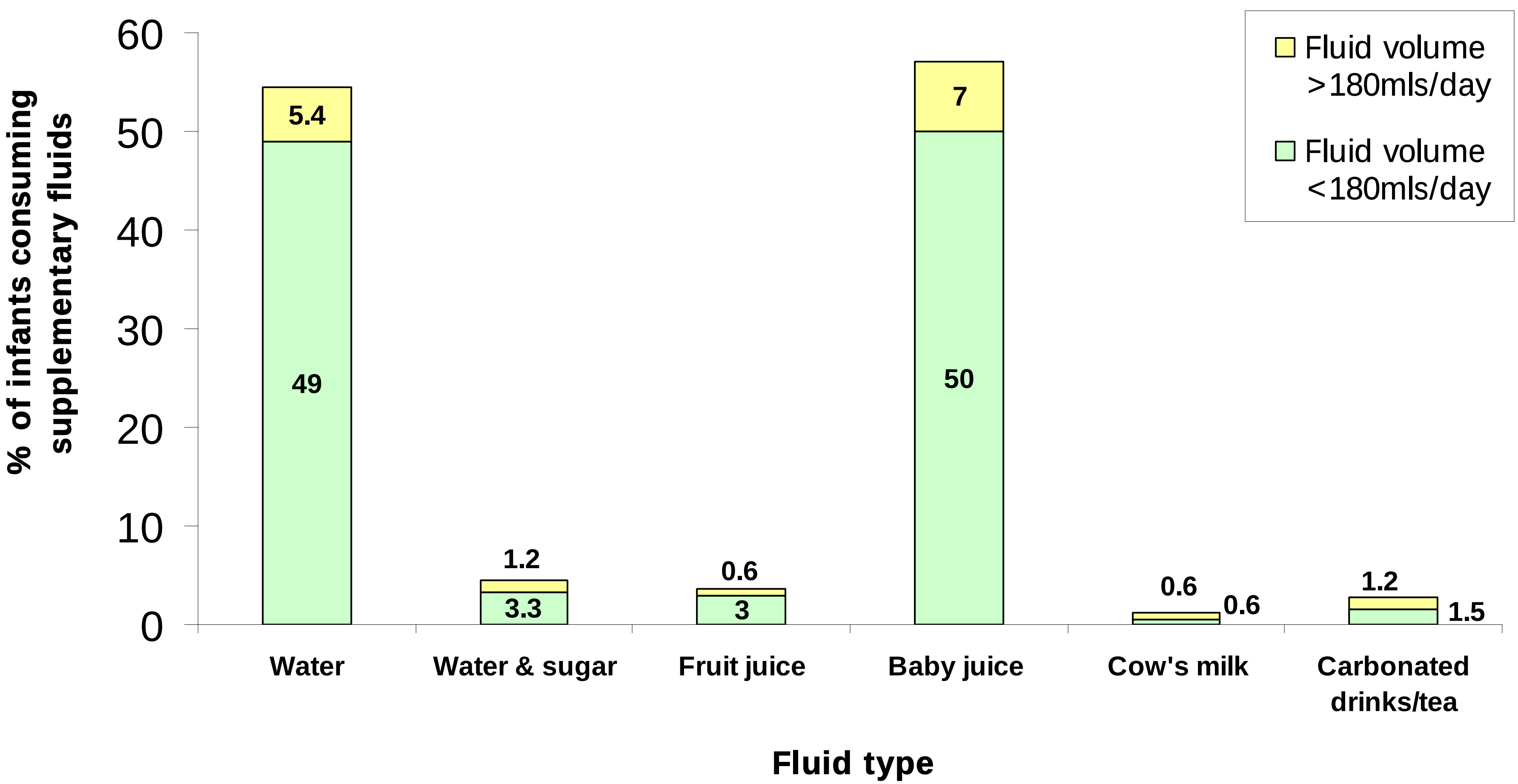
Table 6.2. The proportion of infants in the total population (n = 401) consuming milk and other supplementary fluids at 6-months

Fluid consumed	**Proportion of infants offered this drink (%)**	
Breast milk	39	(9.7)
Formula milk	386	(96)
Casein-based	146	(36)
Whey-based	108	(27)
Follow-on formula	111	(28)
Specialized formula milk e.g. Enfamil AR, SMA Lactose Free	21	(5.2)
Cooled boiled water	180	(44.8)
Water with added sugar/glucose/honey	15	(3.7)
Full fat cow's milk	4	(0.9)
Commercially-prepared baby juice (prepared & undiluted)	140	(34.9)
Commercial baby specific diluted baby syrup e.g. Liga C	47	(11.7)
Ordinary fruit juice e.g. orange, prune, carrot	12	(2.9)
Tea	4	(0.9)
Carbonated drinks e.g. diet 7-Up/cola	5	(1.2)

Volumes of supplementary fluids consumed

Figure 6.1 highlights the volumes of supplementary fluids consumed by infants (n = 329), differentiating between those who consumed volumes <180mls per day and ≥180mls per day. Of the infants who consumed supplementary fluids, equal proportions of infants consumed volumes <180mls of cooled boiled water (49%) and all types of commercially-prepared baby juice (50%). Similar proportions of infants consumed ordinary fruit juice (3%) as water with added sugar/honey/glucose (3.3%) in volumes <180mls daily. Over 2% of infants cumulatively consumed cow's milk (n = 2) and carbonated drinks/tea (n = 5) at volumes <180mls daily with almost 2% of infants consuming these fluids at volumes in excess of 180mls daily (≥180mls/day). Other sugar-containing supplementary fluids including water with added sugar/honey/glucose mixture, ordinary fruit juice and commercially-prepared baby juices were consumed at volumes ≥180mls/day by 1.2%, 0.6% and 7% of infants respectively.

Figure 6.1. Percentage of infants (n = 329) consuming supplementary fluid volumes < 180mls and > 180mls daily



Daily feeding patterns

Figure 6.2 shows the proportion of infants from the total sample (n = 401) consuming three main meals including a breakfast (morning meal event), lunch (mid-day meal event), an evening meal (evening meal event) as well as a dessert (sweet or savoury meal following the mid-day lunch or evening meal) and those who snacked at all (those who consumed at least one snack), on a usual day. The vast majority of infants were consuming a breakfast (96%), a lunch (95%) and an evening meal (89%) at 6-months. In addition to these set daily meals, 42% of infants were consuming a sweet or savoury dessert subsequent to the mid-day or evening meal and 59% consumed at least one snack in-between these meal episodes on a usual basis.

Table 6.3 differentiates the daily meal frequencies between the total population of infants (n = 401) as well as separately examining the meal frequencies between infants who received formula milk (n = 361) or cow's milk (n = 1), known as the 'non-breast fed group', and those receiving 'any breast milk' at 6-months (n = 39). Infants from the total sample consumed almost 3 meals (2.82 solid meals ± SD 0.48) on a usual day, with 82.8% of infants (n = 332) reported to consume 3 meals daily. The non-breast fed group consumed significantly more meals than the 'any' breastfeeding group ($p=0.004$) at 6-months, with mean meal events daily of 2.83 solid meals ± SD 0.45 and 2.69 solid meals ± SD 0.73 respectively, in the two groups. Few infants (n = 5) specific to the non-breast fed group, consumed 4 routine meals on a daily basis including a breakfast, lunch, evening meal, in addition to a late 'supper' consumed in the late evening. Only 10 infants (7 in the non-breastfed group and 3 in the 'any' breastfed group) consumed one meal daily at 6-months.

Figure 6.2. Usual daily feeding patterns (n = 401)

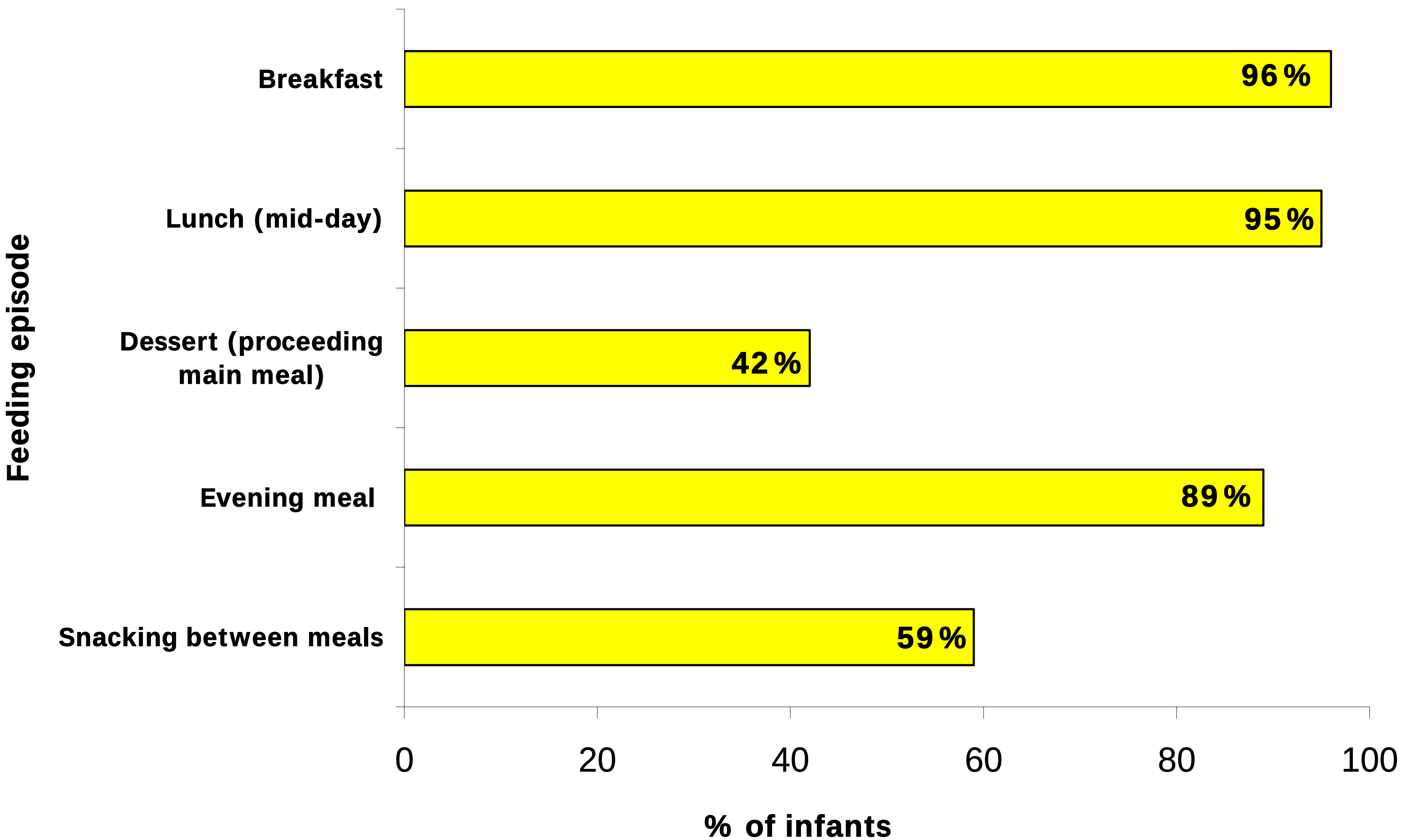


Table 6.3. Daily meal frequency of infants in the total sample (n = 401), in the 'any' breast fed (n = 39) and in the non-breast fed (n = 362) groups at 6-months

Meal frequency	% of infants (n=401)	'Any' breastfeeding % of mothers (n)	Non-breast fed group % of mothers (n)
0*	0.2 (1)	2.6 (1)	0
1	2.5 (10)	7.7 (3)	1.9 (7)
2	13.2 (53)	7.7 (3)	13.8 (50)
3	82.8 (332)	82.1 (32)	82.9 (300)
4	1.2 (5)	0.0	1.4 (5)
Mean solid events daily	2.82 solid meals ± SD 0.48	2.69 solid meals ± SD 0.73	2.83 solid meals ± SD 0.45

*Exclusively breasted infant
SD denotes 'Standard Deviation'

Table 6.4. Snacking frequency of infants in the total sample (n=401), in the 'any' breastfed (n = 39) and in the non-breastfed (n = 362) groups at six months

Snacking frequency	% of infants (n=401)	'Any' breastfeeding % of mothers (n)	Formula fed/other milk with solids % of mother (n)
0	41.4 (166)	64.1 (25)	39.0 (141)
1	44.1 (177)	25.6 (10)	46.1 (167)
2	12.0 (48)	10.3 (4)	12.2 (44)
3	2.5 (10)	0 0	2.8 (10)
Mean snacking frequency daily	0.75 snacks ± SD 0.75	0.46 snacks ± SD 0.68	0.78 snacks ± SD 0.76

SD denotes 'Standard Deviation'

6.4.2 Snacking patterns

Results indicate that snacking was a common practice, with 59% of the total sample (n = 235) consuming at least one snack on a daily basis. **Table 6.4** shows that 44.1% of infants consumed one snack daily with a mean snacking frequency of 0.75 snacks ± SD 0.75 in the total population (n = 401). A substantial proportion of infants consumed at least two snacks daily (12%) while 41.4% of infants did not snack at all.

A significant difference was observed, in terms of mean snacking frequency between those in the 'any' breastfed group (0.46 snacks ± SD 0.68) and the non-breastfed group (0.78 snacks ± SD 0.76) at 6-months ($p=0.019$). The majority of infants in the 'any' breastfeeding group did not snack at all (64%) compared to the non-breastfed group (39%), while more infants in the latter group consumed one snack daily (46%), compared to 25.6% in the former. Almost 3% of infants (n = 10) in the non-breast fed group consumed three snacks daily while no infant who received any breast milk at 6-months consumed more than 2 snacks daily.

Snack foods

As shown in **Table 6.5**, commercially-prepared baby rusks (e.g. 'Liga') and cereals featured as the most commonly consumed snack options by over a third (34%) of the infants investigated while baby yoghurts were consumed by 15% of the sample. A total of 20% of infants were receiving an ordinary or baby biscuit, 7% and 13% respectively. Unsuitable snack options such as plain chocolate, crisps and jelly and ice-cream were reported as usual snack options by 8%, 4% and 1% of mothers respectively. **Appendix XIII** summarizes the specific snack options consumed by infants, differentiated by generic colour coded categories.

Table 6.5. Snacks consumed

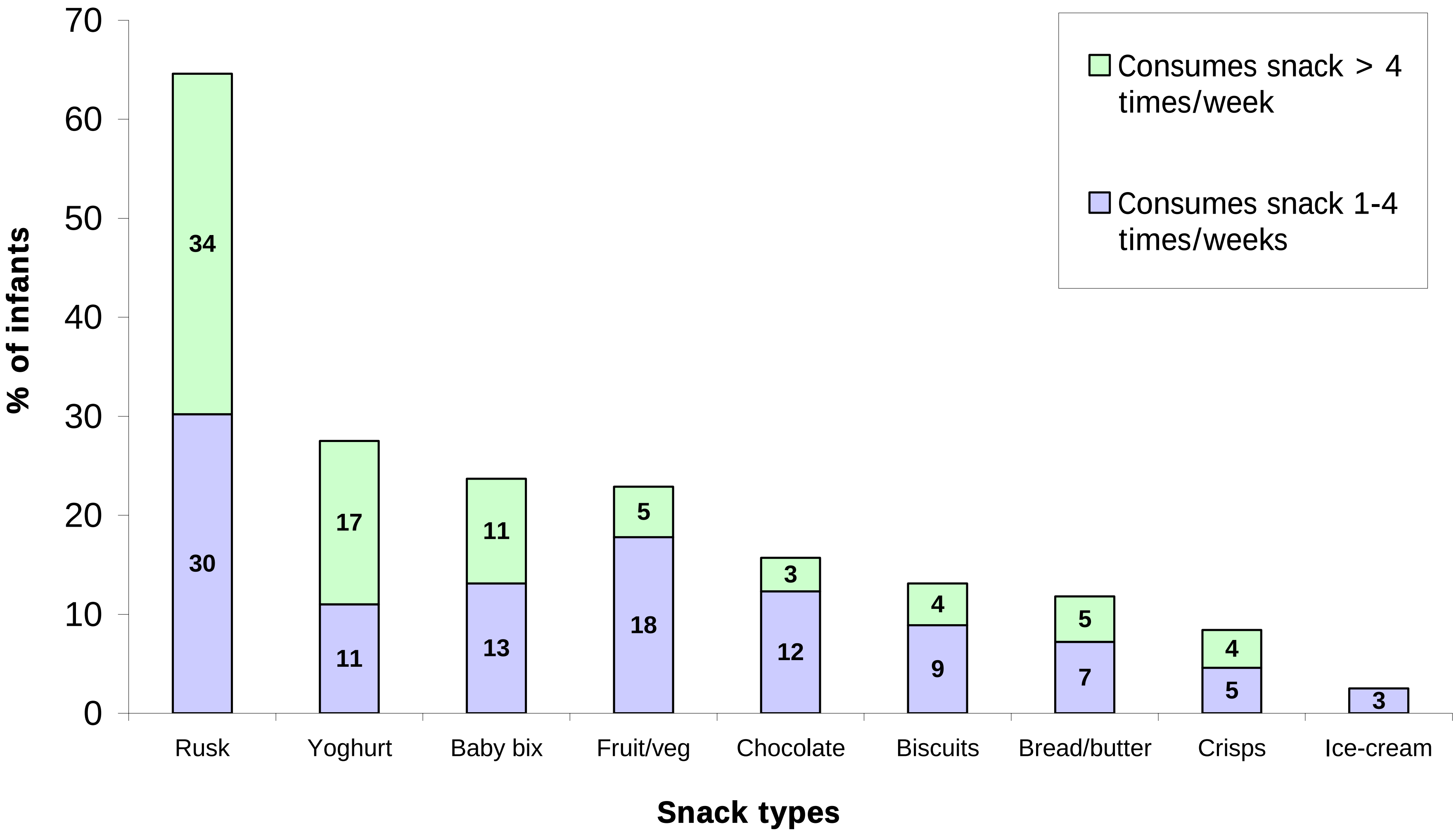
Snack options	**n value**	**% of responses**
Commercial rusk ('Liga')/baby cereal (± fruit/formula milk)	152	34
Baby yoghurt ('Danone', 'Petit Filous')	65	15
Commercial baby biscuits/baby rice cakes	56	13
Fruit/vegetable stick e.g. carrot stick, banana slices, mango, apple, watermelon	53	12
Chocolate e.g. 'Milky bar', chocolate buttons, 'Dairy milk'	37	8
Biscuits/cake e.g. cookies, pink wafer biscuits, shortbread biscuits	31	7
Bread & butter (± jam)	28	6
Crisps (Tayto 'Snax' crisps)	20	4
Ice cream/jelly/lollipop	6	1
Total	**448**	**100**

* See **Appendix XIII** for the specific snack foods consumed by infants, and the sample size (n value) within each group

Snacking frequency

As a food frequency component of the dietary assessment, information pertaining to the infant's usual snack consumption per week was recorded. For the purpose of a more effective interpretation of snacking habits (n=235), snacking frequencies were differentiated as those who consumed a snack between 1-4 times per week and those who consumed a snack > 4 times per week. **Figure 6.3** highlights that infant rusks such as 'Liga' were the most common type of snack being consumed by 30% of infants between 1-4 times per week and by 34% over 4 times per week. Yoghurt was a common weekly snack option of 65 infants with 11% consuming this snack 1-4 times per week and 17% consuming this snack over 4 times per week. A combined 22% of infants (n = 52) consumed both ordinary and baby biscuits 1-4 times per week while 15% consumed these snack options > 4 times per week. A larger proportion of infants consumed fruit and vegetables between 1-4 times per week (18%) than > 4 times per week (5%). Highly sugared and salted snack options such as ordinary chocolate, crisps and ice-cream were consumed 1-4 times per week by 12%, 5% and 3% of infants respectively. Chocolate and crisps were consumed by a total of 7% of infants more than 4 times per week.

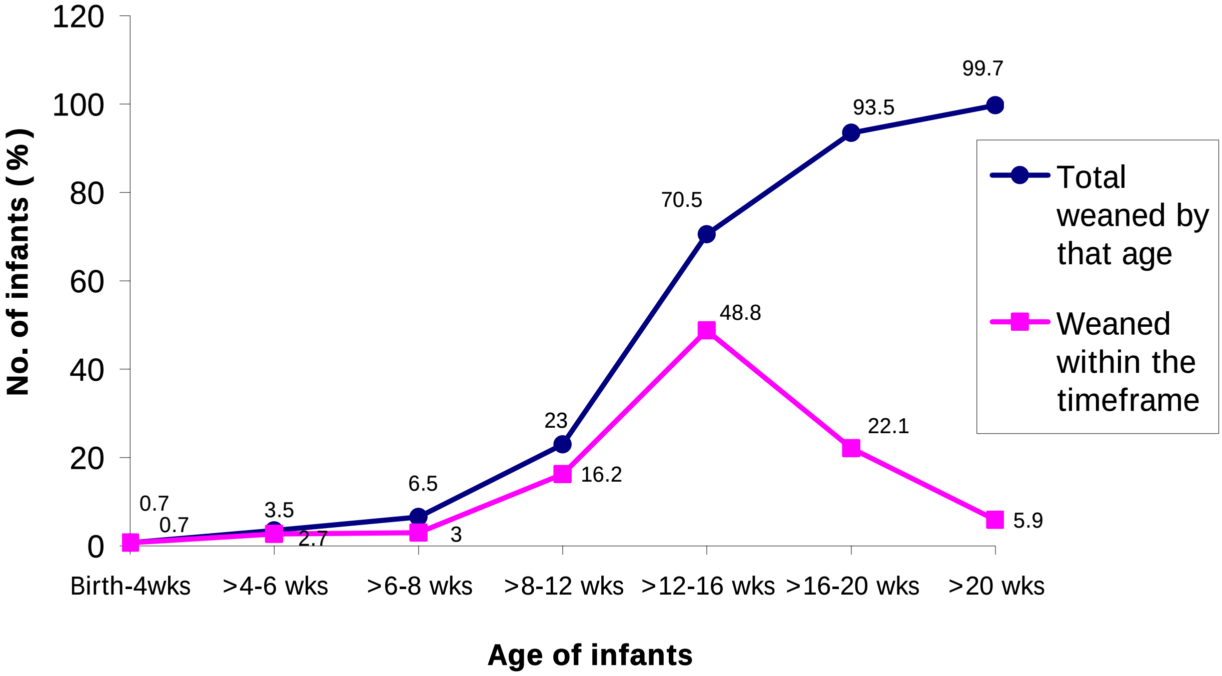
Figure 6.3. Infant weekly snacking frequency (n = 235)



6.4.3 Timing of first weaning foods

The mean timing of introduction to solid foods for the total sample (n = 401) was 15.24 weeks ± SD 3.68 weeks (min-max 3-24 weeks) with a median of 16 weeks. **Figure 6.4** illustrates the timing of first weaning foods by the number of infants weaned by specific time points notably 4 weeks, 6 weeks, 8 weeks, 12 weeks, 16 weeks, 20 weeks and > 20 weeks. The proportion of infants weaned within specific weaning periods is also highlighted including birth to 4 weeks inclusive, from 4.1 weeks to 6 weeks inclusive, from 6.1 weeks to 8 weeks inclusive, from 8.1 weeks to 12 weeks inclusive, from 12.1 to 16 weeks inclusive, from 16.1 weeks to 20 weeks inclusive and those weaned beyond 20 weeks.

Figure 6.4. Timing of introduction to solid food (n = 401)



The vast majority of infants (70.5%) were weaned before the recommended minimum weaning time of 16 weeks, and all but one infant (n = 400) had been weaned by the 6-month follow-up (24.73 weeks). Almost a quarter of infants (23%) had been introduced to solids by 12 weeks post partum with 3.5% weaned by 6 weeks. A large proportion of infants (48.8%) were weaned within the time frame 12.1-16 weeks and between 16.1-20 weeks (22.1%). Similar proportions of infants were weaned between 4.1-6 weeks (2.7%) as between 6.1-8 weeks (3%). A total of 24 infants (5.9%) were weaned beyond 20 weeks.

Comparison of the timing of first weaning foods in formula versus breastfed infants

Significant differences were observed between the timing of first introduction to solid foods during the first 6-months, in terms of feeding status at 6-months notably, between infants in the 'any' breastfeeding group (n = 39) and those in the non-breastfed group (n = 362) (*p=0.000*) (see **Table 6.6)**. Over 7% of infants (n = 26) in the non-breastfed group had been weaned onto solids by 8 weeks compared to no infant in the breastfed group (*p=0.000*). By 16 weeks 71.8% of the non-breastfed group (n = 260) had been weaned onto solids compared to 28.2% of infants (n = 11) in the breastfed group (*p=0.000*). **Table 6.7** shows that infants who were receiving any breast milk at the point of discharge from the maternity hospital (n = 155) were significantly more likely to be weaned later than infants who were formula fed (n = 246) at hospital discharge (*p=0.000*). In particular, just over half (52.9%) of the infants who were breastfed at hospital discharge had been weaned onto solids by 16 weeks compared with the vast majority of their formula fed counterparts (81.7%) (*p=0.000*). **Figure 6.5** illustrates the timing of weaning by feeding status at hospital discharge ('any' breastfed versus non-breast fed) and by feeding status at 6-months (any breast fed and non-breastfed).

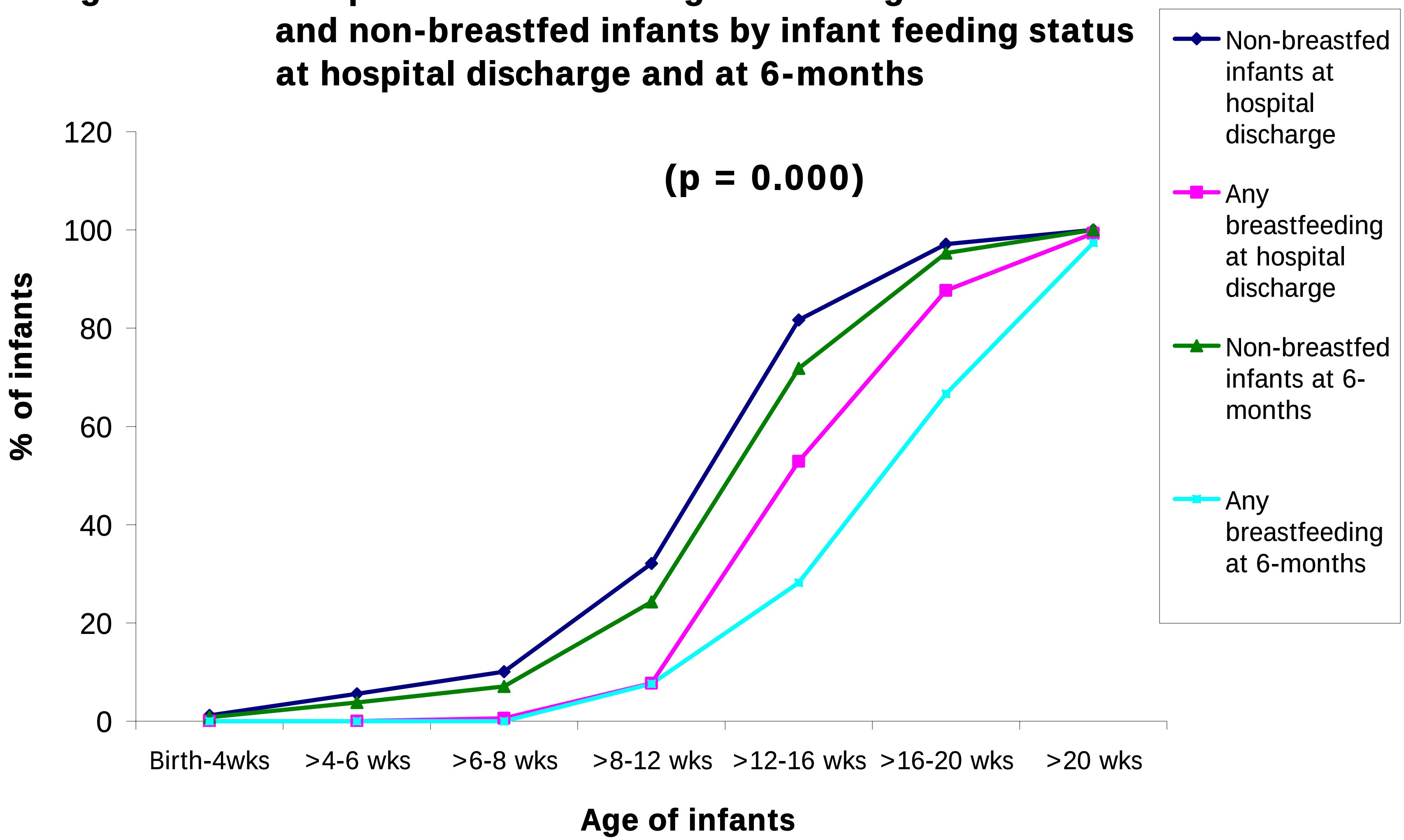
Table 6.6. Timing of first introduction to solid foods by infant feeding status at 6-months including those in the non-breastfed (n=362) and 'any' breastfeeding groups (n = 39)

Timing of first introduction to solid foods	No. of non-breastfed infants weaned by the time points (%)	No. of breasted infants weaned by the time points (%)	*p value*
Birth - 4 weeks	3 (0.8)	0	**0.000**
4.1 - 6 weeks	14 (3.8)	0	**0.000**
6.1 - 8 weeks	26 (7.1)	0	**0.000**
8.1 - 12 weeks	88 (24.3)	3 (7.6)	**0.000**
12.1 - 16 weeks	260 (71.8)	11 (28.2)	**0.000**
16.1 - 20 weeks **0**	345 (95.3)	26 (66.6)	**0.000**
20.1 weeks - 6 months	362 (100)	38 (97.4)	**0.000**

Table 6.7. Timing of first introduction to solid foods by infant feeding status at hospital discharge including those in the 'any' breastfed (n = 155) and in the formula fed (n = 246) groups

Timing of first introduction to solid foods	Any breastfeeding at discharge (%)	Formula fed at discharge (%)	*p value*
Birth - 4 weeks	0	3 (1.2)	**0.000**
4.1 - 6 weeks	0	14 (5.6)	**0.000**
6.1 - 8 weeks	1 (0.6)	25 (10.1)	**0.000**
8.1 - 12 weeks	12 (7.7)	79 (32.1)	**0.000**
12.1 - 16 weeks	82 (52.9)	201 (81.7)	**0.000**
16.1 - 20 weeks	136 (87.7)	239 (97.1)	**0.000**
20.1 weeks - 6 months	154 (99.3)	246 (100)	**0.000**

Figure 6.5. Comparison of the timing of weaning in breastfed and non-breastfed infants by infant feeding status at hospital discharge and at 6-months

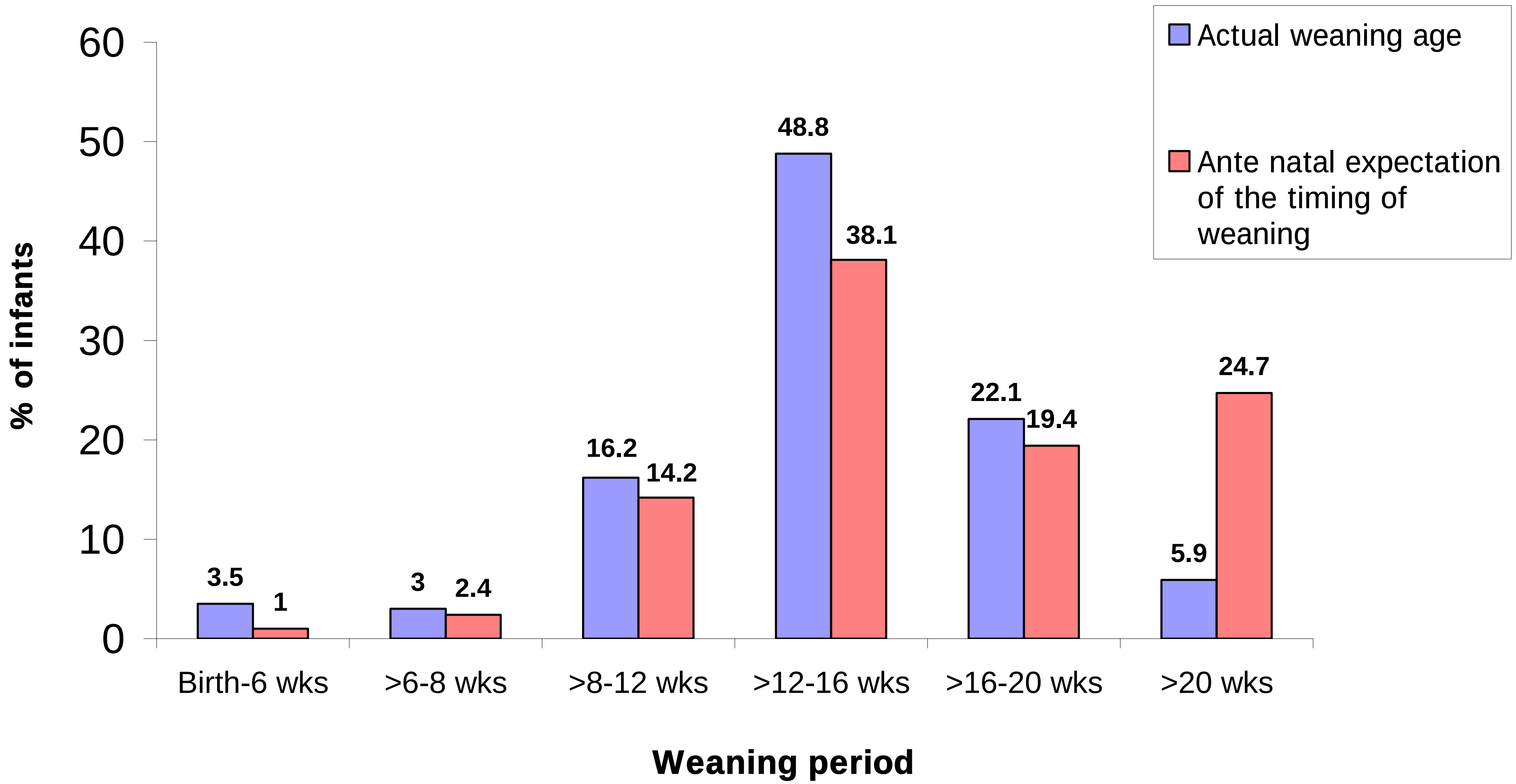


Ante natal expectation of the timing of first weaning foods

As a small component of the ante natal questionnaire 1 (see **Appendix VIII)**, information was collected on mothers 'expected timing' as to when they thought they would initiate weaning post natally. Most mothers (n = 380) provided a numerical response while 9 mothers reported that the timing of weaning 'depends on the infant' and 4 mothers reported that weaning should commence when 'mothers feel that the infant needs more than milk'. Few mothers were unsure of the correct weaning time at the ante natal interview stage (n = 6) and 2 mothers did not provide a response to this question.

As illustrated in **Figure 6.6** mothers' ante natal expectation as to when they thought they would introduce solids was significantly associated with the actual timing of introduction to solids ($p = 0.000$) during all weaning periods post partum. Over 3% of mothers (n = 13) ante natally reported they would wean prior to 8 weeks while 6.5% (n = 26) actually weaned their infants during this time. Similar proportions of mothers ante natally (19.4%) reported, and post natally actually weaned (22.1%) within the weaned period 16.1-20 weeks, indicating that mothers are weaning earlier than they anticipated. Above all, in accordance with weaning guidelines, almost a quarter of mothers (24.7%) intended to wean beyond 20 weeks, however in reality this was achieved by only 5.9% of mothers.

Figure 6.6. Actual weaning time versus ante natal expectation of the timing of weaning



6.4.4 First foods

At the 6-month follow-up, all mothers who had weaned their infants onto solids were asked to indicate the specific food onto which the infant was weaned. As outlined in **Table 6.8** commercially-prepared pureed baby rice (including jars and powdered baby rice made up with cooled boiled water) was cited as the most commonly reported first weaning food by 60% of mothers, followed by an infant specific, commercially-prepared jar or packet of sweetened baby cereal or dessert (non-baby rice variety) offered by 24% of mothers. Few mothers initiated weaning using home-prepared foods such as vegetable (6%) and fruit (3%) purees. Ordinary gluten-containing adult cereals were used by 3 mothers as initial weaning foods including Ready Brek (2 mothers) and Weetabix (1 mother) (see **Appendix XIV**).

Table 6.8. First weaning foods (n = 400)

First foods offered to infants	n value	% of responses
Pureed baby rice (commercial infant specific jar/packet)	239	60
Commercial baby food jar/packet of sweetened baby cereal/dessert	97	24
Home-prepared vegetable puree e.g. carrot/sweet potato	23	6
Home-prepared fruit puree e.g. pear/apple/banana	12	3
Commercial baby food jar of vegetable based puree	9	2
Baby yoghurt	9	2
Commercial baby food jar/packet of fruit puree	4	1
Commercial baby food jar/packet of vegetable & meat mix	4	1
Adult cereal e.g. Weetabix/Ready Brek	3	1
Total	**400**	**100**

* See **Appendix XIV** for the specific first foods consumed by infants, and the sample size (n value) within each group

Breakfast foods

A total of 385 infants (96%) were consuming a breakfast at 6-months. Some mothers reported more than one breakfast option to indicate the infant's usual breakfast food options. The specific breakfast options are listed in **Appendix XV** and these foods are further consolidated and categorized as shown in **Table 6.9**.

Commercially-prepared baby cereals or desserts (with or without added fruit puree) were consumed by the majority of infants (71%). Ordinary adult cereals were the second most prevalent breakfast option consumed at 6-months (14%), all of which were gluten-containing ordinary adult cereals. Similar proportions of infants consumed home-prepared fruit purees (6%) and baby rusks (5%). Two infants consumed an egg-based meal as a breakfast option.

Table 6.9. Breakfast foods consumed by the infants at 6-months

Breakfast options	n value	% of responses
Commercial baby cereal /dessert (± fruit puree)	614	71
Commercial adult cereal e.g. porridge, Ready Brek, Cornflakes, Weetabix, Shreddies	124	14
Home-prepared fruit puree preparation e.g. banana, pear, peach	51	6
Rusk (e.g. 'Liga' ± fruit puree)	41	5
Baby yoghurt (± fruit puree)	17	2
Commercial jar of fruit puree	8	1
Toast with butter/egg on toast	10	1
Total	**865**	**100**

* See **Appendix XV** for the specific breakfast foods consumed by infants, and the sample size (n value) within each group

Lunch foods

95% (n = 382) of infants consumed a mid-day lunch at six months. **Table 6.10** highlights that almost half of the infants investigated consumed a meat based lunch meal (49%) with 31% of infants consuming a commercially-prepared meat and vegetable based meal and 18% of infants consuming a meat or fish based home-prepared meal. Over a third (36%) of infants consumed a vegetable based lunch meal (19% commercially and 17% home-prepared). Almost 14% of infants were consuming a home-prepared unmodified meal including tinned corned beef or Irish stew, oxtail soup, sausage with gravy/mashed potato, coddle, spaghetti bolognaise and chicken with black bean sauce as well as an instant mashed potato known as 'Smash'. **Appendix XVI** lists the specific lunch foods consumed by infants at 6-months.

Table 6.10. Lunch options consumed by the infants at 6-months

Lunch options	n value	% of responses
Commercial baby prepared jar/packet: meat & vegetable option	325	31
Commercial baby prepared jar/packet: vegetable based only	203	19
Home-prepared: baby modified meat/fish & vegetable puree	191	18
Home-prepared: baby modified vegetable based puree	174	17
Home-prepared: baby unmodified vegetable/meat based meal e.g. corned beef, garlic bread, with gravy/oxtail soup, black bean sauce, 'smash' with gravy, coddle	144	13.6
Other: commercially-prepared baby sweetened cereal, baked beans, rusk with formula	12	1
Home-prepared egg dish e.g. scrambled eggs mashed	3	0.3
Total	**1052**	**99.9**

* See **Appendix XVI** for the specific lunch foods consumed by infants, and the sample size (n value) within each group

Evening meal

An evening meal was consumed by 89% of infants (n = 355) with the consolidated meal options listed in **Table 6.11**. Commercially-prepared baby desserts or cereals were offered to almost half of the population (49%). Less than a quarter of infants (23%) consumed a fruit puree (7% commercial and 16% home-prepared) and almost a fifth of infants (18%) consumed yoghurts as an evening meal option. While a large proportion of infants consumed a meat-based lunch (49%), only 3% of infants were offered a meat based evening meal (2% commercially-prepared and 1% home-prepared). A greater proportion of infants were offered an unmodified home-prepared meal for lunch (14%) than for the evening meal (2%). Unmodified, non-baby specific foods as evening meal options included crisps, blended biscuits, butter and jam, ordinary tinned soup with white bread and gravy with meat/mashed potatoes (see **Appendix XVII)**.

Table 6.11. Evening meal options consumed by the infants at 6-months

Evening meal options	n value	% of responses
Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad, rusk	461	49
Yoghurt (baby yoghurt/ordinary yoghurt) (± fruit puree)	170	18
Home-prepared fruit puree	144	16
Commercial jar/packet of fruit puree	68	7
Home-prepared vegetable puree/non-meat based tea	40	4
Commercial jar/packet of meat	18	2
Home-prepared 'un-modified' meals e.g. soup, gravy & potatoes, adult snacks (crisps, bread & butter), mashed biscuits	13	2
Adult cereal e.g. 'Weetabix'/'Ready Brek'	9	1
Home-prepared vegetable & meat puree	10	1
Total	**933**	**100**

* See **Appendix XVII** for the specific evening meal foods consumed by infants, and the sample size (n value) within each group

Dessert foods

As illustrated in **Figure 6.2**, 42% of infants (n = 169) were consuming a daily dessert after the main meal notably subsequent to the mid-day lunch or the evening meal. Baby yoghurts were reported as the most popular dessert option for infants (37%) followed by fruit purees (29%) and commercially-prepared baby desserts (28%). Adult desserts such as blended biscuits, and jelly and ice-cream featured as a dessert option in the diets of 3% of infants (see **Appendix XVIII)**.

Table 6.12. Dessert options consumed by the infants at 6-months

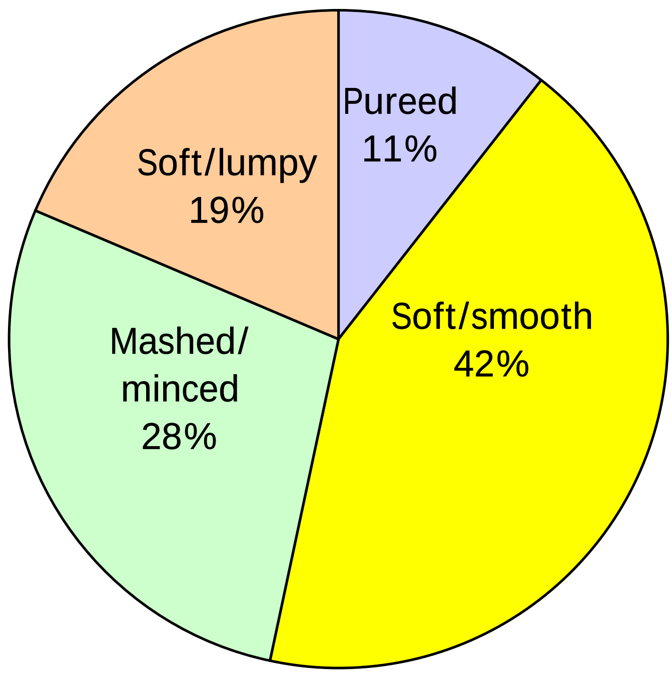
Dessert options	n value	% of responses
Baby yoghurt (natural/flavoured) (± fruit puree)	103	37
Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	79	28
Home-prepared fruit puree	54	19
Commercial jar/packet of fruit puree	27	10
Rusk with added formula milk	9	3
Adult desserts e.g. jelly & ice cream/blended biscuits	7	3
Total	**279**	**100**

* See **Appendix XVIII** for the specific dessert foods consumed by infants, and the sample size (n value) within each group

6.4.5 Food consistency at 6-months

Figure 6.7 illustrates the consistency of the foods consumed by the infants at 6-months. Most infants were consuming a soft/smooth (42%) and a mashed/minced (28%) consistency by the 6-month follow-up time point. The diet consistency associated with the first weaning stage, notably a 'pureed' consistency was consumed by few infants (11%). Almost a fifth (19%) of infants were reported to consume a soft/lumpy dietary consistency which is the recommended consistency associated with the second and third weaning stages.

Figure 6.7. Consistency/texture of foods consumed at 6-months

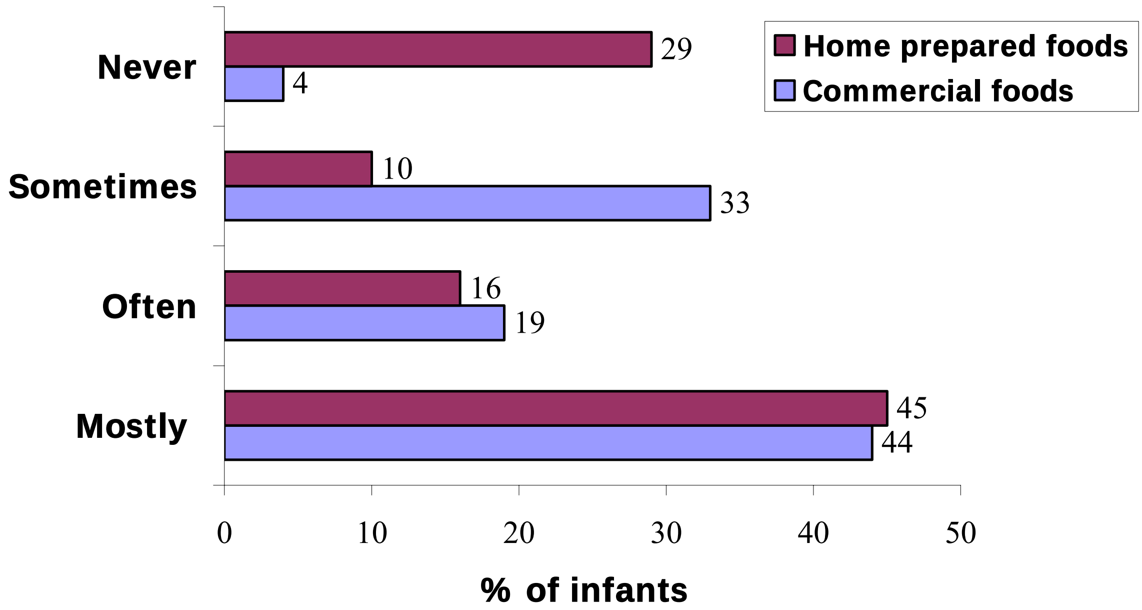


Commercial versus home-prepared weaning foods

Information was elicited on the usual consumption patterns of the home-prepared and commercially-prepared weaning foods offered to infants, using the 4 point Likert scale: 'never', 'sometimes', 'often' and 'mostly'. As shown in **Figure 6.8,** almost equal proportions of mothers reported that they 'mostly' offered home-prepared (45%) as commercially-prepared foods (44%) to their infants. In total, 29% of mothers reported that they 'never' provided home-prepared foods to their infants compared to 4% of mothers who reported that they 'never' provide commercially-prepared weaning foods. The general trend towards the more prevalent use of commercially-prepared weaning foods was further highlighted by the higher proportion of mothers (33%) who reported that they 'sometimes' used commercial baby foods compared to 10% of mothers who 'sometimes' offered home-prepared weaning foods.

Furthermore, mothers in the 'any' breastfeeding group (n = 39), compared to the non-breastfeeding group (n = 362) at 6-months, were more likely to offer home-prepared foods 'mostly or often' (82%) compared to mothers in the non-breastfeeding group (58%) ($p = 0.003$). Similarly, a significant association was observed between the frequency of commercially-prepared baby foods and feeding status at 6-months with 66% of infants in the non-breastfeeding category being offered commercial baby foods 'mostly or often' compared to 36% in the breastfeeding category ($p = 0.001$).

Figure 6.8. Frequency of commercial versus home-prepared foods offered to infants



6.4.6 Additions to weaning foods

Information was elicited on the specific condiments added to the weaning foods *via* an open-ended question. Over a third of mothers (35%) reported that they added extra condiments to the infant foods, with the specific additions outlined in **Table 6.13**. Ordinary gravy was commonly added to weaning foods by 28% of mothers. Other salt-containing additions were also reported including ordinary sauces (17%), vegetable stock (12%) and table salt (2%). Sweet additions such as ordinary sugar and honey were added in 15% of cases.

Of the mothers who added extra condiments to weaning foods (n = 141), 76% reported that they 'mostly or often' offered home-prepared baby foods compared to 24% of mothers who offered home-prepared foods 'sometimes or never' ($p = 0.000$). No significant differences were found between mothers who added extra condiments to weaning foods and those who offered commercially-prepared foods either 'mostly or often' (56%) or 'sometimes or never' (43%) ($p = 0.059$). In addition, mothers who breastfed at 6-months were less likely to add such condiments to the weaning foods (18%) compared to the non-breast fed group (59%) ($p = 0.028$).

Table 6.13. Condiments added to weaning foods (n = 141)

Additions	n value	% of responses
Ordinary gravy	74	28
Butter (salted or unsalted)	51	19
Sauces (bolognaise, black bean sauce, oxtail soup, Sheperd's Pie Sauce from packet, parsley)	47	17
Sugar/honey	41	15
Vegetable stock	33	12
Baby gravy	18	7
Table salt	5	2
Total	**269**	**100**

Additions of solid food to infant feeds

In total, 5% of mothers (n = 18) reported to adding solid foods, including baby rice (n = 7) and baby rusk biscuits (n = 11), to the bottled feeds. The principal reasons for such additions are summarized in **Table 6.14** highlighting 'sleep promotion' (52%) as the central reason for such a weaning practice followed by 'to keep the baby fuller for longer' (21%) and an attempt to entice the baby 'to take the bottle' (10%).

Table 6.14. Mothers' reported reasons for the addition of solid foods to infant feeds

Principal reasons	n value	% of responses
Promote sleep/help baby sleep through the night	15	52
To keep baby fuller for longer	6	21
To entice the baby to take bottles	3	10
For a 'change for the baby'	1	3.4
To calm the baby down	1	3.4
Easier for baby to suck solids from a bottle than eat off a spoon	1	3.4
It's less messy to add solids to bottles than to give solids on a spoon	1	3.4
Improve the palatability of the bottles	1	3.4
Total	**29**	**100**

Meat in the weaning diet

At the 6-month follow-up time point, 66% of mothers (n = 265) reported that their infants consumed some type of meat, either in home-prepared meals (38%), commercially-prepared baby jars (45%) or *via* a combination of home and commercially-prepared meals (17%). Of the mothers who had not introduced meat into their infant's diet (n = 136), the majority reported that they intended to introduce meat by 7 months (53%), 29% by 8 months, 13% by 10 months and 2% beyond 1 year of age. The results highlight several misperceptions among mothers who actively avoided offering their infants meat (**Table 6.15**). The central reason for meat avoidance was related to the mother's perception that the infant's digestion was immature and that the infant was too young for meat (52%) followed by the mother's perception that the infant would choke if offered meat (21% of cases). Some mothers incorrectly felt that meat should be avoided in the weaning diet (2%) while some felt that infant teeth were required for the inclusion of meat in the weaning diet (8%).

Table 6.15. Reasons for meat avoidance at 6-months

Reported reasons	n value	% of responses
Immature digestion/infant is too young for meat	42	52
Afraid the infant would choke if given meat	17	21
Waiting till the infant has teeth	6	8
Vegetarianism	5	6
'Health Scares' surrounding meat: main reason for avoidance	5	6
Dietary preference	3	4
Weaning recommendations advise meat avoidance	2	2
To help reduce the risk of allergy (specific allergies not reported)	1	1
Total	**81**	**100**

6.5 Discussion

One of the reasons this study was undertaken was to assess compliance with current weaning recommendations among national mothers. To minimize confounding, the study aimed to follow up infants within a tight window of one week after the infants turned 6-months. Such efforts resulted in a mean follow-up time of 24.73 ± SD 0.43 weeks (n = 401) thus allowing for a more effective comparison with the recommendations for the 6-month weaning stage as outlined by the Department of Health UK (1994) and the Child Nutrition Panel (2003). In accordance with national and international weaning guidelines it would be expected that most infants followed up at 6-months would fall within the 'first weaning stage' category (**Appendix V**). For instance, it would be expected that most infants would be consuming some pureed/soft solids foods 1-2 times per day with breast or formula milk being the predominant energy and nutrient source. Using the WHO (2001) guideline, notably to exclusively breastfeed and delay the introduction of solids until 6-months, this study found that only one mother adhered to this recommendation. Infants who were not breastfed at 6-months were appropriately consuming modified infant formula milk (n = 386) with the exception of one infant who was consuming full fat cow's milk in the absence of vitamin or mineral supplementation. Although this is a significant improvement from previous research highlighting that 7% of Irish infants were consuming cow's milk by 6-months (Freeman *et al.,* 1998), the increased risk of iron deficiency anaemia cannot be ignored among infants consuming whole cow's milk as a sole milk source during infancy (Hopkins *et al.,* 2007).

The number of mothers who were partially breastfeeding at 6-months was disappointingly low (9.4%). It might have been expected that a larger proportion of mothers would have partially breastfed than exclusively, however, this was not the case as only 9.4% of mothers partially and 0.2% exclusively breastfed. Thus the inclusion of solids in the infant's diet did not appear to promote longer duration of 'any' breastfeeding in the population during the study period.

Timing of weaning

In effect, 70.5% of infants were weaned prior to the minimum recommended weaning time of 4-months. A disappointing 28% of the sample was weaned between 4-6 months, which is the recommended weaning time frame for formula fed infants in Ireland (FSAI, 1999). Delayed weaning (> 6 months) did not appear to be an issue in our sample of infants. Although a large proportion of infants (70.5%) in this study had been inappropriately weaned by 16 weeks, previous Irish research reported that 92% (Freeman, 1996) and 79% of infants (Twomey *et al.,* 2000) were weaned by 4 months, indicating an overall trend towards delayed weaning among Irish mothers over the past decade. Weaning prior to the minimum time of 4 months has been suggested to be a greater problem in the UK, where 93% of Scottish infants were weaned by 4-months (Savage *et al.,* 1998) while the UK National Infant Feeding Survey (Bolling *et al.,* 2007) found that 51% of infants were weaned by 4 months. In contrast, Giovannini *et al.,* (2004) demonstrated that 34% of infants (n = 2,450) in Italy had been weaned onto solids by 16-weeks; Hornell *et al.,* (2001) reported similar findings among infants in Sweden (34% weaned by 16-weeks). Thus, such data highlight that it is possible for mothers to delay weaning beyond 16-weeks.

Of greater public health concern was the finding that early weaning was a common practice among national mothers with 23% of infants consuming solids by 12 weeks while over 4% of infants had been weaned by 6 weeks. **Chapter 7** will consider the factors associated with premature weaning ≤ 12 weeks, and other inappropriate weaning practices, which will enable a greater understanding of the reasons underpinning their occurrence. Similar to our findings, Ford *et al.,* (1995) in New Zealand, and Wright *et al.,* (2004) in Scotland demonstrated that 20% and 21% of infants respectively, had been weaned onto solids by 12 weeks. In comparison with the previous Irish research (Freeman, 1996), 68% of infants were weaned by 12 weeks in 1996 versus 23% of infants as found in this study, indicating an improvement in this study towards later weaning beyond 12 weeks over the last 10 years. The fact that almost 6.5% of infants in this study were consuming solids by 8 weeks presents a marked public health challenge. Similarly, a previous regional Irish study by Twomey *et al.,* (2000) indicated that 7% of infants in Dublin (n=197) were weaned by 8 weeks, highlighting that very early weaning is not exclusive to the mothers in this study. Considering the well researched adverse health consequences of early weaning, including the reduced absorption of nutrients in breast or formula milk (Department of Health UK, 1994; Wharton, 1999), the potential reduction in breast and formula milk intake (Nutrition Child Panel, 2003), increased food intolerance and eczema (Fergusson & Horwood, 1994) risk and the link with obesity during childhood (Wilson *et al.,* 1998), this issue warrants greater attention.

Ante natal expected timing of weaning

A novel finding in this study was that mothers' ante natal expectation as to when they thought they would introduce solids post natally was significantly related to when they actually weaned their infants post partum ($p=0.000$). This association persisted ($p=0.000$) during all the weaning periods examined. It is noteworthy that mothers were not asked to specify the current recommended weaning time in this study, nor were they provided with any weaning guidelines, however, information was elicited during the ante natal period on their personal beliefs as to when they expected to wean their infants post partum. Few studies have examined this ante natal and post natal relationship in terms of timing of weaning which may be interpreted from several angles. Firstly, mothers' ante natal feeding intention may be a stronger influence on the timing of weaning than the weaning advice received during the first 6-months. This is highlighted by the particular trend towards the high proportion of mothers who ante natally expected to wean during the period 12.1-16 weeks (38.1%) and the majority of mothers whom actually weaned within this weaning period post partum (48.8%) ($p=0.000$). One may assume that most mothers would have received weaning advice incorporating the recommended weaning time at some stage during the first 16 weeks post partum, however, the ante natal intention to wean prior to 16 weeks appeared to exert a stronger influence than the advice of best weaning practices. Secondly, the fact that more mothers actually weaned their infants by 12 weeks post partum (23%) than had been ante natally expected (17.6%) indicates that despite the knowledge among mothers that early weaning is inappropriate for infants, changing circumstances post partum over rode this information. It could be postulated that the weaning advice provided to mothers post partum should have further delayed actual weaning in the population beyond 8 weeks. However, it is likely that mothers whom ante natally expected and post natally actually weaned prior to 8-weeks, received any weaning information owing to the fact that weaning advice is usually initiated at 12-weeks by the PHN (see **Appendix XII**).

Supplementary fluids

Consistent with existing weaning research (Graham *et al.,* 1998; De la Hunty *et al.,* 2000), 82% of infants in this study were consuming supplementary fluids in addition to breast or formula milk. Although the weaning guidelines (Department of Health UK, 1994; FSAI, 1999) recommend that cooled boiled water should be the first choice supplementary fluid offered to infants, this fluid was the second most common fluid consumed by infants (n = 180), the most common being commercially-prepared baby juices (n = 187). This finding is consistent with results from the ALSPAC study, showing that the consumption of flavoured drinks (24.2%) among 4-month old infants was significantly greater than that of cooled boiled water (8.7%) (Emmett *et al.,* 2000).

Despite the fact that the recommendations discourage the use of sugar-containing supplementary fluids in lieu of cooled boiled water prior to 6-months, diluted fruit juices or baby drinks can be given as part of a meal in volumes not exceeding 120-180mls daily (AAP, 2001). Several infants (10%) in this study however, consumed sugar-containing supplementary fluids in excess of 180mls per day including water with added sugar (1.2%), fruit juice (0.6%), baby juices (7%) and carbonated drinks (1.2%). International weaning research has indicated similar findings with possibly higher proportions of infants reported to consume sugar-containing fluids during infancy. Briefel *et al.*, (2004a) found that 22% of 4-6 month old infants in the US consumed 100% fruit juice, with a mean volume of 120mls consumed daily. In line with our results, Sarwar (2002) found that 42% of infants in the UK consumed baby juices and ordinary fruit juices; however carbonated drink consumption (9%) was higher than that observed in this study.

It has been suggested that infants do not need fruit juices or baby fruit juices as both breast and formula milk are nutritionally complete and are adequate sources of vitamin C until 6-months (Department of Health UK, 2006; Shaw & Lawson, 2007). Increasing research suggests that excessive weight and adiposity have been linked to high energy-containing beverage consumption in children (Troiano *et al.,* 2000; Ludwig *et al.,* 2001). Moreover, children with dental caries have been shown to have higher median intakes of sugared drinks at 2, 3, 4 and 5 years of age than those without dental caries (Marshall *et al.,* 2003).

In view of the evidence that a disproportionate intake of sugar-containing fluids during infancy may increase satiety, lead to sub-optimal nutrition (Harnack *et al.,* 1999), toddler diarrhoea (Hoekstra, 1998), non-organic failure to thrive (Smith & Lifshitz, 1994) and tooth decay (Holt, 1997), a need to address the high consumption of large volumes of sugar-containing fluids at 6-months, in lieu of cooled boiled water is indicated. It may be that health professionals are unaware of the high usage of sugar-containing supplementary fluids among mothers as it is assumed that cooled boiled water is the expected first choice supplementary fluid. The possibility that mothers may be ignorant of the health consequences of the regular provision of sugar-containing fluids to their infants must also be considered. Northstone *et al.*, (2001) postulated that mothers may resort to offering their infants sweetened drinks and foods as they perceive them as preferred by infants. In addition, the public health weaning leaflets read by mothers in Ireland do not specify a recommendation on the use of sugar-containing supplementary fluid volumes, presenting a current deficiency in weaning information. Primarily, these results indicate that weaning advice to mothers should emphasise cooled boiled water as the recommended supplementary fluid. Advice should also be given on the recommended volumes of sugar-containing supplementary fluids (120-180 mls/day), encourage further dilution of juices of 1 part juice in 8 parts water (Department of Health UK, 2006) and emphasise their exclusive use during mealtimes. Including and specifying the adverse health effects associated with the regular consumption of large volumes of sugar-containing supplementary fluids may also promote healthier practices.

Feeding patterns

All expert groups agree that infants have unique nutritional requirements and develop at varying stages, and thus, should be managed individually (WHO, 2001; SACN, 2003). The majority of energy and nutrients should still be provided by a minimum of 600mls of breast or formula milk at 6-months of age (Child Nutrition Panel, 2003), in addition to 1-2 spoon-feeds daily (see **Appendices V** and **VI**). In contrast to the 'typical' or expected dietary pattern of 6-month old infants, this study found that the majority of infants were consuming a breakfast (96%), lunch (95%) and evening meal (89%) in addition to a dessert (42%) and at least one snack (59%) in a 'usual' or typical day. It is noteworthy that infants (n = 386), in addition to these meals, were also consuming a mean formula volume of 828mls ± SD 226mls (min-max 90-1480mls). Despite the fact that quantitative information was not collected on the portion sizes of the solids consumed, it could be deduced, relative to the specific feeding recommendations for 6-month olds as summarized in **Appendix V** and **VI**, that many infants were consuming a diet similar to that of an older toddler, akin to the final weaning stage. Moreover, despite the inclusion of almost 3 meals daily (mean 2.82 ± SD 0.48) in this sample of infants, solid intakes did not appear to affect, or decrease, daily formula volumes.

As recommended for older infants between 9-12 months, the majority of the 6-month old infants investigated in this study were consuming 3 meals daily (n = 332) and consuming at least one snack (n = 177). To further contribute to the complexity of this issue, a large proportion of infants were consuming a dietary consistency associated with the intermediate (6-9 months) and final weaning stages (9-12 months), notably consuming a mashed/minced (28%) and lumpy (19%) dietary consistency. In contrast, few infants were consuming a pureed (11%) consistency associated with the initial weaning stages (4-6 months).

Although snacking 2-3 times between meals is a recommended practice for infants between 9-12 months (Thomas & Bishop, 2007) owing to their small stomachs and high levels of activity, the results highlight that snacking was a regular dietary pattern among the 6-month old infants investigated in this study. Considering the high number of meals consumed daily by most infants, the appropriateness of snacking as a regular practice at the 6-month weaning stage must be addressed. According to Jahns *et al.,* (2001), it is vital that snacks are nutritious, well planned and that they complement the energy and nutrients provided by meals. In this study, many of the snack types provided to infants including chocolate (8%), biscuits (7%), crisps (4%) and ice-cream

(1%), were typically high in energy, saturated fat, trans-fats, salt and non-milk extrinsic sugars (added sugars). In the absence of a quantifiable examination of weekly snacking frequencies, it may be suggested that some mothers were offering such unhealthy snacks as a harmless 'taster' to infants on a 'now and again' basis; however, closer examination reveals that such inappropriate snack options were consumed more than 4 times per week by 11% of infants. Regardless of the portion sizes, the regular provision of these snacks to infants highlights a public health and nutritional concern. Moreover, Whitney *et al.*, (2001) suggested that sweet foods of any kind, including baby food desserts, should not feature in an infant's diet, since the added dietary energy provides few nutrients to support growth and contributes to obesity. Recommended snacks and those that are perceived as healthier, such as fruit and vegetables were consumed by 12% of infants, while a similar proportion of infants consumed commercially-prepared baby biscuits (13%). From a nutritional and public health viewpoint, it is disconcerting that more infants consumed baby biscuits > 4 times per week (11%) than fruit or vegetables (5%). In addition, it is also worrying that 3% of infants were consuming a sugar-containing adult dessert such as blended biscuits, jelly and ice-cream 1-4 times per week. Of significance, findings demonstrate an overall pattern towards regular snacking behaviour with a preference towards snacks high in sugars, fats and salt rather than low energy, nutrient dense snacks such as fruit, vegetables and yoghurt. Current evidence indicates that such an unfavourable feeding pattern may result in unhealthy consumption patterns beyond infancy with a greater propensity towards regularly consumed, rather than unfamiliar foods. For instance, foods that were infrequently consumed by children, tended to be less liked (Cooke & Wardle, 2005) while 50-60% of the variance in 3-4 year olds preference for a particular food was explained by its degree of familiarity, as well as sweetness, which was found to be related to earlier exposure (Birch, 1979). In particular, early introduction to fruits and vegetables during weaning has been shown to result in higher frequency of consumption of these foods among 2-6 year olds (Cooke *et al.,* 2004). Considering the high frequency of consumption of baby biscuits (11% consuming biscuits > 4 times per week) relative to the proportion of infants consuming fruit and vegetables (5% consuming fruit/vegetables > 4 times per week) found in this study, it could thus be deduced that parental efforts to promote fruit and vegetable consumption among some of the infants in this study during later in infancy, and beyond, may prove challenging. Moreover, food neophobia emerges at around 2 years of age and is associated with lower dietary quality and variety and a lower intake of fruit and vegetables (Cooke, 2007). Considering the evidence that early food experiences can determine later food preferences, the unsuitable weaning foods consumed by some infants in this study could deleteriously affect their long-term compliance with healthy eating guidelines. Furthermore, research shows that coronary vascular disease is an evolving process with early precursors such as raised intimal lesions present between 8 and 10 years of age (Kleinman, 2000); such evidence indicates that the diet during the early years of life can influence and impact on later health.

Few studies have examined the snacking patterns of infants at 6-months. Since current guidelines do not support the need for solid foods until 6-months, it could be deduced that infant snacking at 6-months would be a rare practice. However, consistent with our results, a USA based study conducted by Kay-Fox *et al.*, (2004) reported that 10% of 4-6 month old infants were consuming at least one serving of highly sugared desserts, sweets and beverages on a daily basis, contributing minimally to an adequate micro nutrient status. A longitudinal study tracking infant and toddler snacking behaviours demonstrated that an adult pattern of 3 meals with between-meal snacks began at 7-8 months, and was well established by 9-11 months (Skinner *et al.,* 2004). In agreement with our findings, an adult pattern of feeding behaviour was evident among infants at 6-months.

Research has already demonstrated that 4-6 month olds may be consuming energy intakes 10% in excess of their estimated energy requirements (Delaney *et al.,* 2004). Interestingly, guidelines aimed at reducing energy intakes in overweight and obese children (see **Appendix XIX**) encourage the exclusion of chocolate, sweets, cakes and biscuits, encourage more vegetables and salads, the use of fruit in place of desserts and the avoidance of fatty and fried foods (Shaw & Lawson, 2007). It could be argued that these guidelines may be applicable and relevant to a large proportion of infants in this sample. Considering the daily formula volumes consumed by infants in this study, along with high meal and snacking frequencies at the early age of 6-months, the prevalence of inappropriate snacks and the consumption of foods high in fats and sugars, excessive energy intakes relative to requirements among some infants could also be assumed. Moreover, snacking is likely to play an important role in the development of overweight and obesity (Savige *et al.*, 2007). Our results thus support the necessity for further research in Ireland to quantitatively examine energy and nutrient intakes during infancy.

Foods consumed

The majority of infants were appropriately weaned onto low allergenic foods with baby rice as the most common first food reported by 60% of mothers, similar to other reports indicating its use among 74% of mothers (Wright *et al.,* 2004). Three infants were offered a gluten-containing cereal as a first weaning food compared with 11.7% of Italian infants who were reported to consume a gluten-containing cereal as a first food (Giovannini *et al.,* 2004). As cited in previous Irish reports (Freeman *et al.*, 1998), commercially-prepared infant cereals featured strongly in the diet of 6-month old infants in the present study with 71% consuming a baby cereal for breakfast while 84%

of infants consumed a commercial cereal as a first weaning food. Infant cereals have been reported by other investigators as being the predominant grain-based food in the early weaning diet (4-6 months) consumed by 66% of infants (Kay-Fox *et al.*, 2004). Relatively few mothers inappropriately added solid foods to their infant feeds (5%) in comparison with previous studies highlighting this practice among 31% of mothers in the USA (Crocetti *et al.,* 2004). Over half of the mothers (52%) in this study reported 'sleep promotion' as the chief reason for adding solids to infant feeds, a belief which may result in the introduction of solid foods before the infant has developed the skills to eat from a spoon (Brown, 2005).

Although feeding guidelines recommend that a variety of foods and preparations should be offered to infants to develop a range of tastes and textures, 88% of first foods offered to infants were commercially-prepared and only 9% were home-prepared purees. A similar pattern was observed during all meal episodes with the majority of infants consuming a commercially-prepared meal for breakfast (72%), lunch (50%) and the evening meal (58%). Findings from the UK National Survey (Hamlyn *et al.,* 2002) equally found that mothers were more likely to offer commercially-prepared foods (62%) between 4-5 months than home-prepared foods (38%). To corroborate the results from a previous Irish study (Twomey *et al.,* 2000), which showed that few families used home-prepared foods (10%) during the initial weaning period, there was a general trend among mothers in this study to offer commercially-prepared baby foods (see **Figure 6.8**). Crucially however, results highlight that some mothers did not adhere to healthy eating cooking guidelines associated with the home preparation of modified baby meals. This was indicated by 14% of mothers who offered an unmodified lunch meal including gravy with mashed potato and tinned corned beef and 2% who offered an unmodified evening meal. Of equal concern was the finding that over a third (35%) of mothers added highly salted and sugared condiments to infant foods that would typically feature in an adult diet, such as ordinary gravy (28%) and sauces (17%). Unsurprisingly, these mothers were significantly (*p=0.000*) more likely to offer home-prepared foods 'mostly or often' than 'sometimes or never' to their infants. Taken together, such data suggest a need for the provision of more practical information (verbal, written, cookery demonstrations) pertaining to infant-specific meals and recipes to parents and care-givers, along with health-related reasons for such food avoidances.

Similarly, in a cohort of Spanish mothers (n = 344) van den Boom *et al.,* (1995) found that the majority of mothers added salt (68%), and to a lesser degree, sugar (19%) and honey (11%) to the home-prepared infant foods. Moreover, Heird *et al.,* (2006) reported that in the absence of added salt, the sodium content of home-prepared foods should be similar to that of commercially-prepared infant and toddler foods. Our results are of key public health concern owing to evidence that diets high in salt during infancy cultivate a taste for salted foods (Harris & Booth, 1985; Harris, 1993). Although evidence is lacking to establish the time of onset of 'diet sensitivities' in hypertensive adults who are sodium sensitive (Kleinman, 2000), Zinner *et al.*, (2002) suggested that a high sodium intake during early life could contribute to the risk profile for higher blood pressure later in life. In addition, it is well established that the consumption of added sugars should be limited to avoid the risk of dental caries in the first teeth (Konig & Navia, 1995) and the development of a high 'sweetness' taste threshold (Birch, 1998). Moreover, it is well established that human infants are born with a preference for sweet taste (Beauchamp & Moran, 1982), further emphasising the importance of minimizing the added sugar content in the early diet. The possibility that some mothers may be unsure of how to modify a baby meal must be considered (Sarwar, 2002), as well as a lack of awareness of the adverse consequences associated with such practices.

It has been suggested that some infants may benefit from the consumption of commercially-prepared infant foods rather than home-prepared foods (Stordy *et al.,*

1995) owing to the varying composition of home-prepared weaning foods (Morgan *et al.,* 1995). Other investigators have attributed adequate dietary iron intakes in 6-9 month old infants to a high intake of fortified infant formulas and commercial infant food (Mills & Tyler, 1992). Moreover, the quantity of commercial baby food consumed at 8 months has been shown to exert a positive influence on infant iron stores (Wharf *et al.,* 1997). Despite the nutritional benefits of commercially-prepared foods however, the level of absorption of nutrients, in particular iron, has been shown to be relatively low (Fairweather-Tait *et al.,* 1995). Daly *et al.*, (1998) confirmed that infants fed commercial baby foods had significantly higher intakes of iron ($p<0.034$) but significantly lower zinc intakes compared to those fed home-prepared foods. Although fortified commercial baby foods have been shown to play a role in infant diets, particularly with regard to iron and infant cereals, healthy eating guidelines call for more emphasis on sound dietary practices, which are founded from infancy. Moreover, a dependence on commercially-prepared infant foods during the first year of life may result in difficulties in introducing home-prepared foods (Harris, 1993). Subsequently, these findings highlight that a greater emphasis should be placed on educating mothers of the importance of offering nutritious, balanced and modified, home-prepared baby foods. Furthermore, information on the precise method and preparation of such foods should be a crucial component of weaning advice.

Differences between formula and breastfed infants

An important finding in the present study was the significant differences observed between infants who were in the 'any breastfeeding' and in the non-breastfed category, in terms of weaning practices at 6-months. Although the sample size of the 'any' breastfed group at 6-months was small (n = 39) the effects were strong enough to detect and show that these infants significantly consumed fewer meals ($p=0.004$) and snacks ($p=0.019$) than their non-breastfed counterparts. Overall, healthier weaning practices and improved compliance with weaning recommendations were observed in mothers who breastfed at 6-months. These mothers were also significantly less likely to add inappropriate weaning condiments to the weaning foods ($p=0.028$) and more likely to delay weaning until the minimum recommended time of 4 months ($p=0.000$) compared with their non-breastfeeding counterparts. In particular, 24.3% of non-breast fed infants were prematurely weaned (≤ 12 weeks) compared to only 7.6% in the 'any' breastfed group ($p = 0.000$) at 6-months. In agreement with our data, a study from the UK consisting of larger sample size (n = 476) (Noble & Emmett, 2006) showed that 7.9% of breastfed infants had been weaned by 12 weeks compared 20% of formula fed infants ($p=0.01$).

Greater compliance with weaning guidelines was observed among mothers who attempted to breastfeed at all is further highlighted when the timing of weaning is examined by 'feeding status' at hospital discharge. Mothers who breastfed at hospital discharge (n = 155) were significantly more likely to delay weaning during the first 6-months, compared to mothers who formula fed at hospital discharge (n = 246) ($p=0.000$). Less desirable weaning patterns among formula fed infants have been indicated in previous studies showing that these infants were more likely to have been weaned earlier, to have consumed fruit flavoured drinks and less likely to have consumed fruit and vegetables (Noble & Emmet, 2006). It has been shown that the energy and protein intakes are higher in formula-based diets than breast milk-based diets at 6-months of age (Heinig *et al.,* 1993b; Atladottir & Thorsdottir, 2000). Importantly, the evidence highlights an association between energy intake at age 4 months in formula fed, but not breastfed infants and a higher BMI at age 5 years (Ong *et al*., 2006). According to Dietz (2001), the differing weaning practices between formula and breastfed infants cannot be precluded when examining the early origins of obesity (Dietz, 2001).

Strengths and limitations of the study

The data presented in this chapter provide novel information about current weaning practices in a sample of mothers in Dublin. The value of the results are strengthened considerably by the large sample size, as well as the fact that infants were followed up within a well defined time frame of 6-months; this achievement has enabled more accurate data interpretation and comparison with other infant feeding studies (Skinner *et al.,* 1997; Nolan *et al.,* 2002; Kay-Fox *et al.,* 2004). In addition, since the follow-up of infants spanned a two-year period and the data were collected during all twelve months of the year, any day of the week or seasonal bias was minimized.

It is well documented that accurate assessments of dietary intake are a pre-requisite for assessing the relationships between diet and health (Livingstone, 1995). The fact that semi-categorized quantitative dietary assessments were collected *via* one maternal 24-hour recall, rather than using the preferred 3-day weighed record assessment, is recognised as a limitation of this study. Firstly, the 24-hour recall was reliant on the mother's memory at the time of the interview. The possibility that some mothers may have verbally under or over estimated infant food intake must also be considered (Livingstone *et al.,* 2004). If mothers underestimated usual infant dietary intakes however, it would be likely that the results would be even more alarming than what is reported. Nonetheless, studies have suggested that there is less day-to-day dietary variation among infants (Wharf *et al.,* 1997) and that the maternal 24-hour recall is a valuable assessment method, providing unbiased estimates of infant dietary intakes (Dop *et al.,* 1994).

In addition, owing to social desirability and memory bias, mothers may have omitted certain food items or failed to admit to an unfavourable feeding practice. Although 24-hour dietary recall data have been shown to provide a direct measure of an infant's food consumption by age (Briefel *et al.,* 2004a), use of a 3-day weighed record (North *et al.,* 2000) or the conduction of more than two 24-hour dietary assessments at different times during the study period (Kay-Fox *et al.,* 2006), would have provided more accurate insight into infant dietary patterns over a prolonged period of time and memory bias may have been less likely (Rolfes *et al.,* 2006b). Furthermore, no information was elicited on infant nutrient intakes in this study nor were anthropometric measurements of the total sample collected, making it difficult to make firm conclusions as regards energy balance or associations with nutritionally-related disease outcomes. A more accurate interpretation of the feeding patterns of infants at 6-months would have been complemented by the conduction of nutritional assessments and knowledge of detailed energy and nutrient intakes, however, due to practicality and time limitations owing to the large sample size and one investigator; this exploration was not undertaken in this study.

In contrast to previous infant feeding studies that stipulated the main caregiver (Freeman *et al.,* 1998) or main caregiver/parent (Skinner *et al.,* 2004) as the individuals who reported on the infant's diet, the present study consistently reported on the mother's recall of the infant's diet, thus possibly increasing the accuracy of the data elicited. The fact that the maternal dietary recall reported on the infants 'usual' diet increased our confidence that the results are, by and large, representative of the diets of the 6-month old infants in this study. Moreover, in keeping with the study inclusion criteria, it was assumed that the vast majority of these infants were healthy and were not consuming specialized diets that necessitated an increased energy or nutrient requirement. Inter-observer variation was limited in this study owing to the one investigator conducting the dietary assessments; however, the fact that different interview styles were used when conducting telephone interviews than face-to-face interviews *via* home visits was recognised as a study limitation. Increased face-to-face contact during the interviews with some mothers (n = 125 and n = 97 face-to-face contacts at 6-weeks and 6-months respectively), may have contributed to a greater rapport and bond with these mothers resulting in potential response bias. None-the-less, every effort was made by the investigator to ensure consistent interview methods throughout the study population.

6.6 Conclusions

In conclusion, results demonstrate that a large proportion of mothers in Dublin failed to comply with the weaning recommendations at 6-months. Of major concern, the vast majority of mothers initiated weaning before the recommended time point of 4 months. Public health policy makers in Ireland may need to evaluate the feasibility of promoting the WHO (2001) recommendations for all infants here in Ireland. An awareness of what infants are currently consuming at the early stage of 6-months, when breast or formula milk should be the predominant food source, contributes greatly to our paediatric knowledge base. Particular concern was highlighted by the foods consumed by some infants in this study. The longer-term effects of the food preferences high in energy, salt, sugar, sweeteners, trans-fatty acids and saturated fats may adversely influence later health (Dennison, 1996; AAP, 2001; Zinner *et al.,* 2002; Mikkila *et al.,* 2004) as well as influence child food preferences (Skinner *et al.,* 2002b). A more persistent public health emphasis on healthier food choices during weaning is likely to positively influence mothers, however increased devotion and investment into resources and educational programmes is required. Crucially, weaning information requires greater specification with regard to appropriate volumes of sugar-containing supplementary fluids and home-preparation of infant foods. Considering our increasing childhood obesity levels, and the degree of obesity, weaning advice needs to strongly discourage the regular practice of inappropriate snacking at 6-months.

The findings in this study strongly suggest a role and a need for the implementation of a national weaning protocol. The initiation of weaning advice could be considered as early as the ante natal period either as a component of the ante natal talks to mothers, or *via* the provision of an 'infant feeding pack' during the last trimester of pregnancy. PHN's could consider the incorporation of a 'weaning checklist' in verbally advising mothers about best weaning practices, which may limit the possibility that some information may not be imparted. Ensuring that all mothers receive a public health weaning leaflet may strengthen the advice imparted by the PHN. A greater awareness among health professionals of the high prevalence of early weaning prior to 12 weeks and of the unsuitable weaning foods provided to infants is important; however, effective and standardised strategies are needed to improve compliance with weaning recommendations.

Childhood obesity has risen to the top of the public health agenda in Ireland and paediatricians are urged to counsel parents to address the at-risk child's eating behavioural patterns (Nader *et al.,* 2006). Considerable evidence suggests that overweight toddlers may grow into overweight school-age children (Allen & Myers, 2006). In view of the large formula volumes consumed, regular meal and snack frequencies, and the large proportion of infants who consumed high energy foods of poor nutrient density at the early stage of 6-months, increased risk of overweight may be considered among these infants. For this sample of infants who are growing up during a period of increasing obesity prevalence, aggressive public health interventions should be considered, targeting the first year of life as a primary priority. Results suggest that examining infant energy and nutrient intakes relative to requirements in Irish infants is an area worthy of further investigation. A longitudinal follow-up of this cohort during childhood, incorporating the collection of biochemical and anthropometric data, would offer valuable insight into the influences of early feeding behaviour and patterns on later health.

Finally, comparisons drawn between previous Irish infant feeding research suggests an overall trend towards improved weaning practices over the latter decade. It is thus realistic and achievable in our population of mothers to influence change and strive towards best practice.

Chapter 7

Determinants of Inappropriate Weaning Practices, incorporating the Relationship with Infant Growth

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7.1 Introduction

Evidence is accumulating to suggest a strong link between early feeding patterns and later food preferences and eating habits in childhood (AAP, 1997; Stang, 2006). Ensuring a weaning diet that is conducive to healthy feeding behaviours during infancy and toddler hood provides the foundations for the prevention of chronic diseases during later life. In Ireland, the prevalence of obesity among children aged 5-12 years is high, ranging from 4.1%[†] to 11.2%[*] in boys and from 9.3%[†] to 16.3%[*] in girls (O' Neill *et al.,* 2007). Depending on the definition used, obesity in Irish children aged 8-12 years old has increased by two-to-four-fold between 1990 and 2005. It has been suggested that the epidemic of overweight children worldwide requires that healthy eating guidelines should be applied during early life (Briefel *et al.,* 2004b). Above all, there is convincing evidence that the diet in infancy may have an effect on health (Freeman *et al.*, 1998) and overweight risk during childhood (Wilson *et al.,* 1998; Ong *et al.,* 2000) and adulthood (Stettler *et al.,* 2005). It is also established that rapid weight gain during infancy increases the risk of obesity in childhood and adulthood (Stettler *et al.,* 2003; Baird *et al.,* 2005) which may set the stage for weight issues for a lifetime. Although it has been recognised that the risk for the development of nutritionally-related diseases can commence from birth, and that conception to two years is the critical period for nutritional intervention (UN Standing Committee on Nutrition, 2006), it has been remarked that infants from 0-6 months are one of the most under represented groups in health research and prevention programs (Flynn *et al.,* 2006). Moreover, since feeding patterns during the first year of life are important for the establishment of food consumption patterns throughout life, and influence subsequent growth, development

[†] Obesity defined using the International Obesity Task Force age-and sex-specific BMI cut-offs
[*] Obesity defined using the actual relative weight (ARW)

and morbidity (Department of Health UK, 1994), it is thus crucial to increase our understanding of these patterns and investigate their determinants.

Chapter 6 provided data on the type of foods and fluids mothers offered their 6-month old infants, which was important in ascertaining the proportion of mothers who adhered to current weaning recommendations. Characterising the population groups that failed to follow these recommendations in the Irish-specific context remains a knowledge gap that calls for further investigation. Considering the extent of non-compliance with weaning recommendations as reported in this study (see **Chapter 6**), few Irish-based infant feeding studies have investigated the reasons as to *why* a large proportion of mothers fail to comply with optimal infant feeding guidelines.

7.1.1 Inappropriate weaning practices

Table 1.5 describes a host of inappropriate weaning practices, one of which is the premature introduction of solid foods prior to 12-weeks post partum. The global guideline to delay the introduction of solids until a minimum of 4 months (Department of Health UK, 1994; FSAI, 1999; ESPGHAN, 2008) has scientific validity with reference to reducing the infant risk of recurring chronic eczema (Fergusson *et al.*, 1990; Morgan *et al.*, 2004b; Tarini *et al.*, 2006), allergy (Moore *et al.*, 1985; Hasan-Arshad, 2001; Halken, 2004), iron deficiency anaemia (Oski & Landaw, 1980), respiratory illness (Wilson *et al.*, 1998) and persistent cough (Forsyth *et al.*, 1993). Earlier research associated early weaning with hypernatraemic dehydration (Wilkinson & Davies, 1978; Davies *et al.*, 1979). Although the relationship between early weaning and obesity risk is unclear, the American and European Committees on Nutrition have suggested that the early introduction of solid foods may result in excessive weight gain (AAP, 1980; ESPGHAN Committee on Nutrition, 1982).

Some studies demonstrated heavier weight among infants weaned <15-weeks (Ferris *et al.,* 1980; Forsyth *et al.,* 1993; Wilson *et al.,* 1998) while other reports have suggested that early weaning does not alter infant weight or length from 4-6 months (Cohen *et al.,* 1994) nor growth or body composition during the first (Mehta *et al.,* 1998) or second year of life (Agras *et al.,* 1990).

Although limited data exist on the longer-term health consequences of such varying weight differences, and other health outcomes in terms of timing of introduction to solid foods, it remains an important population public health priority to encourage weaning at the recommended time of 4-6 months for nutritional and developmental reasons. It has been established that the introduction of solid food before an infant is developmentally ready may delay the timely appearance of other feeding developmental milestones (AAP, 1998). Furthermore, the level of pancreatic enzymes to support adequate digestion may be inadequate until the infant is 6-months of age (Hendricks & Badruddin, 1992). However, despite the widely publicised guideline to delay weaning until a minimum of 4 months, a large proportion of mothers continue to ignore this advice (Wharton, 2000). Studies investigating early weaning have used various premature weaning cut-off points including 12-weeks (Kajosaari & Saarinen, 1983; Forsyth *et al.,* 1993; Alder *et al.,* 2004; Morgan *et al.,* 2004a; Wright *et al.,* 2004), 15-weeks (Wilson *et al.,* 1998) and 16-weeks (Fergusson *et al.,* 1990; Baker *et al.,* 2004; Crocetti *et al.,* 2004).

Several other inappropriate weaning practices were highlighted in this research as warranting further examination. The fact that 141 mothers' added highly salted inappropriate condiments, such as gravy and vegetable stock to the weaning foods (see **Table 6.13**) indicates that there is room for improving the quality of infants' diets. Pioneering research undertaken by Harris & Booth (1985) examined the exposure-acceptance relationship of 6-month old infants for salted and unsalted foods, concluding that the acceptance of salt in food was related to the infants' prior experience of salt at 6-months. More recently, it has been demonstrated that the mean sodium intake of 6-11 month old infants exceeded the adequate intake (AI) by 33% (Heird *et al.*, 2006). It is noteworthy that the period between 6-12 months coincides with the introduction of table foods and a more diverse diet. Furthermore, it is well established in adults, that an increasing sodium intake results in a continuous increase in blood pressure (Sacks *et al.*, 2001). Of major concern is that a high sodium intake during infancy may increase the likelihood of hypertension in adulthood (Zinner *et al.*, 2002).

The provision of snacks high in sugars and saturated fats, with poor nutrient densities, including ordinary biscuits, crisps, chocolate, cake and ice-cream was reported in 63 of cases in the present study. In reference to current weaning guidelines, snacking among 6-month olds is not indicated as a typical or recommended practice (Department of Health UK, 1994). It has been suggested that foods high in energy and low in nutrient density are inappropriate for infants in this age group, particularly when micronutrient needs are high (Briefel *et al.,* 2004b). Above all, a high snacking frequency during childhood (Kubik *et al.*, 2005) and adulthood (Keski-Rahkonen *et al.*, 2007) has been highlighted as a contributory factor to the development of overweight and obesity. Moreover, in the US, 10% of a cross-sectional sample of 4,722 two to five year old children were found to be overweight (Ogden *et al.*, 2002) while in a UK report, 15.8% of two year old infants (n = 1, 031) were reported to be overweight and 6% obese (Reilly *et al.*, 1999). Although limited longitudinal research has examined the effect of early 'inappropriate' snacking patterns on long-term overweight risk, it is likely that these two variables are inter-related. In reference to current weaning guidelines, there is little debate that snacking, in addition to routine solid meals, is inappropriate for the majority of healthy 6-month old infants (Department of Health

UK, 1994). However the provision of 'unsuitable' snacks to infants during this early stage of infancy is alarming, and deserves more in-depth investigation.

7.1.2 Determinants of poor compliance with weaning guidelines

The literature indicates that several factors need to be considered when determining poor weaning practices such as lack of knowledge and maternal misperceptions surrounding weaning, which may be compounded by economic and social problems (Thomas & Bishop, 2007). Morgan *et al.,* (1995) reported misconceptions among mothers in their attitudes to 'healthy eating for infants', including the finding that 83% of mothers felt a high dietary fibre intake was important or very important, while 20% considered that plenty of energy was not important for infants. Maternal adherence to familiar feeding practices that have empirically been successful with previous siblings may also contribute to poor infant feeding practices (Savage *et al.,* 1998). Data from Boyington & Johnson (2004) suggest that parental perceptions are important in determining early weaning, including maternal perceptions of infant body size. Moreover, a recent report from the UK reported that a parents' perception of infant hunger was an independent predictor of early weaning (Wright *et al.,* 2004). Horodynski *et al.,* (2007) suggested that understanding mothers' knowledge, attitudes and normative influences can provide critical information for addressing perceived barriers to feeding recommendations. However, investigators in this area have concluded that despite having adequate knowledge of best weaning practices, some mothers continue to ignore this advice, and base their practices on influences from their social network (Anderson *et al.,* 2001). Previous infant feeding studies emphasise that familial and psychosocial influences may exert a greater effect on maternal feeding practices than the professional advice received (Matthews *et al.,* 1998).

There is little doubt that socio-economic variables are of paramount importance when investigating determinants of poor health behaviours. Social, economic and educational inequalities have been correlated with health outcomes at all ages (Acheson, 1998). It has been suggested that the timing of weaning reflects prevailing cultural attitudes to childcare and maternal factors such as age, education and social class (Harris, 1988). Previous studies from the UK have identified maternal socio-economic status as being hugely influential on the types of foods fed to children (North & Emmet, 2000; Wright *et al.,* 2004). According to research from Canada (Dubois & Girard, 2003b), mothers from a higher, compared to lower socio-economic status were 70% less likely to introduced cow’s milk as a sole milk drink into their infants diets by 9-months (OR 0.375, CI 0.24-0.58). In a sample of socially disadvantaged mother-infant pairs in the UK, Daly *et al.*, (1998) demonstrated that 72% of infants had received solids by 3-months.

Maternal education, recognised as a marker of socio-economic status (Heck *et al.*, 2006), has also been identified as a key determinant of weaning practices in that mothers with a lower level of education were significantly more likely to wean early (Savage *et al.*, 1998; Kwavnick *et al.*, 1999; Fewtrell *et al.*, 2003) and introduce squashes, hot drinks, tea, coffee and cow’s milk into the diet of their infants, than better educated mothers (North *et al.*, 2000). De La Hunty *et al.*, (2000) found that less educated mothers were more likely to feed their infants low fat milk at a younger age, continue to use bottles beyond one year and were less likely to give supplementary vitamins to their infants. Moreover, as a component of the Euro Growth study, Freeman *et al.*, (2000) found that the prevalence of iron deficiency anaemia in infants was four times higher in low (11.2%) versus high (2.7%) socio-economic families owing to the high consumption of cow’s milk in the former group.

To mitigate the health inequalities between lower and higher socio-economic groups at a population level, an improved understanding of these ‘at risk’ groups of mothers is necessary to create, initiate and promote successful public health interventions. Identifying mothers who are less likely to comply with weaning recommendations is vital for nutritional education and for the distribution of effective public health support, resources and assistance to these mothers. An in-depth exploration of the potential deficiencies that support the continuation of poor weaning practices among mothers in Dublin is essential to effectively improve their feeding practices, attitudes and psychosocial network. Knowledge of the factors that influence the occurrence of poor weaning practices may in turn improve ante and post natal care.

Thus, a priority in public health policy should be the further exploration of the determinants of inappropriate weaning practices and an examination of the reasons underpinning their existence. While international research offers valuable insight into the socio-economic and attitudinal influences on sub-optimal weaning practices, a comprehensive examination of the determinants that support their existence in the Irish context deserves greater attention. Early environmental and dietary modification across all socio-economic groups at a local and national level may contribute to the improved health of future generations.

7.2 Aims and objectives

The aim of this study was to identify the factors that predict inappropriate weaning practices. The specific objectives were to:

- ✓ Identify the factors that predict the early introduction of solid foods, using $\leq$ 12-weeks as the cut-off definition for early weaning.

- ✓ Profile the mothers who failed to comply with weaning recommendations including mothers who offered inappropriate snacks to their infants and those who added inappropriate condiments to the infant weaning foods.

7.3 Methodology

The general methodology of this study is described in **Chapter 3** and details of the specific methodology relevant to the weaning data collection are outlined in **Section 6.3**. The inclusion criteria for the analysis of data specifically for this chapter incorporated all infants born to national mothers who were weaned onto solid foods during the first 6-months post partum (n = 400). One mother-infant pair was excluded as the mother was exclusively breastfeeding and thus had not introduced solid foods into her infant's diet by the 6-month follow-up time point.

In this study, mothers who had weaned ≤ 12-weeks post partum were included in the 'early weaning' group (n = 91). The determinants of early weaning thus required the creation of a dichotomy between the early weaning group (n = 91) and those who weaned beyond 12-weeks (n = 309). For clarification purposes, the 'early weaning group' and 'mothers who weaned early' are synonymous terms with those who weaned ≤ 12-weeks, and the 'late weaning group' denotes mothers who weaned >12-weeks post partum. 'Infancy' in this study was defined as birth to 12 months (FSAI, 1999).

The latter section of this chapter profiles the socio-demographic and feeding characteristics of mothers who conducted inappropriate weaning practices. Specific practices that were isolated as being important to examine included:

1.) Mothers who added inappropriate condiments such as gravy and sauces (see **Table 6.13** for specific condiments**)** to the weaning foods (n = 141).

2.) Mothers who offered their infants unsuitable snacks, specifically: crisps, chocolate, ordinary biscuits, cake and ice-cream (n = 63). It is noteworthy, that in total, 235 mothers offered any snack foods to their infants (see **Figure 6.3**), however, the provision of unsuitable snack options including crisps, chocolate, ordinary biscuits, cake and ice-cream was observed in 63 cases.

For the purpose of statistical analyses and more effective interpretation of the data, categorical variables were created with no more than 3 groups in each category, with the exception of maternal social class, which included 5 groups (see **Section 2.9**). Categorical variables relevant to this chapter are defined and justified as follows:

7.3.1 Timing of return to work

The timing of return to work for mothers was categorized into those who returned to work '≤ 18 weeks' and '> 18 weeks' post partum. During the study period, notably from June 2004 until October 2006, and in accordance with the Maternity Protection Act 1994 and the Maternity Protection (Amendment) Act 2004 applicable to this period, maternity leave in Ireland entitled mothers to 22 weeks paid maternity leave. As a compulsory requirement, the Maternity Protection Act (1994) also stipulated that pregnant women were required to take a minimum of 2 weeks maternity leave prior to the birth, resulting in 20 weeks maternity leave post partum. Mothers also had the option to take 12-weeks unpaid leave beyond the 22 weeks paid leave, in line with the maternity law in situ during the time of the study. As most mothers take 4 weeks paid leave ante natally, return to work '≤ 18 weeks' and '> 18 weeks' were the parameters used in the present study.

7.3.2 Birth weight

Birth weights were plotted on the Child Growth Foundation centile charts in accordance with the infant's gestational age at birth and gender. According to these centile charts, which are based on reference data from a normal healthy population of infants, birth weights < 2.99 kg fall naturally within the '< 9^{th} centile' (small for gestational age). Birth weights between 3.0 – 4.5 kg are plotted between the '9^{th} – $91^{st'}$ centiles (appropriate for gestational age) and birth weights > 4.5 kg fall into the > 91^{st} centile (large for gestational age).

For the purpose of categorization of infant birth weights in the present study, the following category values were created as:

1.) < 2.99 kg: small for gestational age

2.) 3.0-4.0 kg: appropriate for gestational age

3.) > 4 kg: large for gestational age

7.3.3 Ante natal classes

During the first interview (≥ 24 weeks gestation), mothers were questioned as regards their attendance at ante natal classes and were asked to indicate the number of classes attended until this point. Since the mean gestational age of mothers at recruitment was 35.18 weeks ± SD 4.26 weeks (min-max 24-42 weeks), it is highly likely that not all mothers would have commenced their ante natal classes by the time of the first interview. Thus for clarification purposes, the variable 'attendance to ante natal classes' in this study may under represent actual attendance at the classes within the total sample, as it is likely that mothers who were recruited during the early part of the third trimester attended ante natal classes during late pregnancy, beyond the point of the first interview.

In addition, as the ante natal classes commence at 30 weeks gestational age in the Coombe Women's Hospital (see **Section 5.1.1),** a secondary sub-analysis was conducted to examine the association between ante natal class attendance and early weaning among mothers '> 30 weeks gestational age'. This measure aimed to better represent the mothers who were likely to have commenced the ante natal classes and examine the association with early weaning.

7.3.4 Statistical analysis

As part of the first section of this chapter, univariate analyses were carried out to observe associations between mothers who weaned early (≤ 12-weeks) and variables that are indicated in the literature as being important influences on the timing of weaning

(Twomey *et al.,* 2000; Horodynski *et al.,* 2007). Univariate analyses included contingency table analysis using Chi-Squared tests to assess determinants of early weaning. Binary logistic regression was then used to determine the variables that independently predicted early weaning.

In accordance with the literature (Harris, 1988; Ford *et al.,* 1995; Kwavnick *et al.,* 1999; Hamlyn *et al.,* 2002; Giovannini *et al.,* 2004), variables that were considered risk factors for early weaning were examined in the univariate analysis including: maternal/paternal socio-demographic factors, infant characteristics, maternal health behaviours and employment factors, infant feeding status during the first 6-months and mothers' sources of infant feeding information. Mothers' reported sources of infant feeding information during the ante natal period, at 6-weeks and 6-months, as summarized in **Tables 7.7**, **7.8** and **7.9** respectively, represent the analysis of multiple response answers, thus all categories incorporate a 'yes' or 'no' response. Such data were analysed using Chi-squared test and the Yates's continuity correction value. **Table 7.10** however, represents the analysis of an open-ended question to mothers 'reported weaning sources of information'. Responses to open-ended questions were consolidated and analysed using the 'defining multiple response sets' option in SPSS and were further aggregated manually under general group headings. For instance, the general group 'family' may incorporate sister, mother-in-law, aunt and mother.

Following an exploration off the individual associations between mothers' reported 'reasons for introducing solid foods' and 'early weaning' in the univariate analysis, the significant individual responses were further entered into the logistic regression. The open-ended responses to 'mothers reasons for introducing solid foods' were also consolidated and analysed using the 'multiple response sets' option (see **Table 7.14**). Using the significant variables observed from the univariate analyses, more detailed binary logistic regression was performed to predict the independent associations with early weaning.

Early weaning ≤ 12-weeks was the dependent variable; the independent variables were those that were highlighted as being significant in the univariate analysis including maternal age and education, feeding mode at 12-weeks, ante natal feeding expectation of timing of weaning post partum, reasons for initiating weaning and mothers weaning information sources. The codes *1 = weaned ≤ 12-weeks* and *0 = weaned > 12-weeks* were created and binary logistic regression was used to calculate the odds ratios (OR's) and 95% confidence intervals. Multiple forward stepwise logistic regression was performed using SPSS for Windows (version 13.0) consistent with previous research (Alder *et al.,* 2004). In order to examine the associations between the explanatory variables and the introduction of solid foods prior to 12-weeks, multivariable models were created, based upon theoretical constructs and the results of the univariate modelling. Factors were retained in the model if they were significant at the $P < 0.05$ criterion. The first run of the logistic regression model incorporated the key variables that were identified during the univariate analysis. These variables were entered singly into the regression model. Only the variables that showed statistical significance for early weaning in the multivariate model were introduced into the final regression models. The importance of each variable, adjusted for the others in its group, was assessed by the Wald χ^2 and the odds ratios (OR) with 95% CI. The logistic regression models controlled for maternal age, education, smoking status, parity, infant birth weight and gestational age of infants at birth, enabling the identification of the 'independent predictors of early weaning'. Final binary logistic regression models were created to form a '*socio-demographic*' model and an '*attitudinal and psychosocial model*'. The overall fit of a logistic regression model was assessed using the 'log-likelihood statistic' (-2LL). According to Field (2005b), large -2LL values indicate a poorly fitting statistical model, thus, a decrease in the -2LL value following the addition of a variable indicates that the model is predicting the outcome variable more accurately.

Relationships between two continuous variables were assessed using the Pearson product-moment correlation co-efficient (r value) (see **Table 7.4b**). Preliminary analyses were first performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity, using in particular the Kolmogorov-Smirnov statistic which assessed the normality of the distribution of continuous variables (**Sig. value >0.05** indicates normality).

The Spearman's Rank Order Correlation (r_s) was used as the non-parametric alternative. A correlation of 0 indicates no relationship, -1 indicates a perfect negative correlation and +1 indicates a perfect positive correlation (Field, 2005a). In addition, as an interpretative guideline used in this study and in accordance with Cohen (1988):

- ✓ A small correlation is indicative of an **r value = 0.10 to 0.29**
- ✓ A medium correlation is indicative of an **r value = 0.30 to 0.49**
- ✓ A large correlation is indicative of an **r value = 0.50 to 1.0**

'Percentage of variance' is an estimation of how much variance two variables share and is calculated by squaring the *r value*, and multiplying the figure by 100 to estimate the percent of variance. A correlation of r = 0.5 for example, means that there is 25% shared variance between two variables (Pallant, 2007a).

The profiling of mothers who conducted 'inappropriate' weaning practices was performed in the second section of this chapter (see **Section 7.4.10**). Chi-squared tests were used to test for significant differences between early weaning and the categorical variables. The Yates's continuity correction value was used for all 2x2 tables. Significant variables were those that met the criterion $P < 0.05$.

7.4 Results

By 12-weeks post partum, 23% of infants (n = 91) had been weaned onto solid foods. Results of the univariate analysis outlined in **Tables 7.1** to **7.14** highlight associations between early weaning (≤ 12-weeks) and relevant socio-demographic and infant-related characteristics.

7.4.1 Socio-demographic factors and health behaviours during pregnancy

As outlined in **Table 7.1**, significant differences were observed between mothers who weaned ≤ 12-weeks and >12-weeks in terms of maternal characteristics including maternal age ($p=0.000$), education level ($p=0.000$) marital status ($p=0.000$), social class ($p=0.000$) and health insurance status during pregnancy ($p = 0.000$). In particular, younger mothers ≤ 24 years were significantly more likely to wean early (38%) compared to mothers ≥ 35 years of age (7%). Within the early weaning group, the vast majority of mothers had 'public health insurance' during pregnancy (75%) compared to only 3% of mothers who had private health insurance ($p = 0.000$). While 10% of the total sample were single mothers, 21% of mothers in the early weaning group were single mothers compared to only 7% who weaned >12-weeks ($p=0.000$). Similarly, mothers who were educated to primary or secondary school level were over represented in the early weaning category (63%) and under represented in the late weaning category (33%) relative to the proportion of mothers who were educated to primary/secondary level in the total sample (40%) ($p=0.000$). The proportion of mothers in Social Class 3 and in the social class denoted by the 'unknown category' (students and unemployed) were also over represented in the early weaning group, by 22% and 23% of mothers respectively, compared to the proportion of mothers in the total sample (11% and 11% of mothers respectively). The majority of mothers who weaned > 12-weeks were in Social Class 1 (36%) and Social Class 2 (33%) while few mothers who weaned ≤ 12-weeks were in Social Class 1 (13%).

Similar associations were observed with regard to the partners' socio-demographic characteristics such as age (*p=0.02*), education level (*p=0.000*) and social class (*p=0.000*) (see **Table 7.2**). A greater proportion of partners in the early weaning group were ≤ 24 years (22%), educated to primary/secondary level (64%) and in Social Class 3 (76%) than what would be expected by their proportions in the total sample, by 13%, 40% and 50% of partners in each category, respectively. Few partners with a third level education level (6%) had infants who were weaned early compared to over a third of partners in the later weaning group (35%).

Of the mothers who weaned early, almost two thirds (63%) reported an unplanned pregnancy while the vast majority of mothers who weaned > 12-weeks (70%) reported a planned pregnancy (*p=0.000*). Parity was not significantly associated with early weaning (*p=0.146*).

A significantly higher proportion of smokers weaned early (43%) and a lower proportion weaned > 12-weeks (18%) in comparison to the proportion of smokers in the total sample (23%) (*p=0.000*) while there was no association found between weaning time and alcohol consumption during pregnancy (*p=0.308*) (see **Table 7.3**).

Table 7.1. Proportion of National Mothers who introduced solids prior to (≤) 12-weeks post partum by maternal socio-demographic characteristics[&]

Maternal socio-demographic characteristic	Total sample of 400 mothers %	Early Weaning Group (n = 91) %	Late Weaning Group (n = 309) %	Significance *p value*
Age group (yrs)				
≤ 24	22	38	18	
25-34	60	55	61	
≥ 35	18	7	21	**0.000****
Health insurance status				
Public	49	75	41	
Semi-private	37	22	42	
Private	14	3	17	**0.000****
Marital status				
Married	59	29	68	
Unmarried	31	50	25	
Single	10	21	7	**0.000****
Living arrangement with partner				
Home/apartment owner	73	56	78	
Non-home owners	27	44	22	**0.000****
Mothers' education level				
Primary & secondary	40	63	33	
Vocational/training course	29	31	28	
Third level degree/post-graduate	31	7	39	**0.000****
Maternal social class [+]				
Social Class 1	31	13	36	
Social Class 2	31	24	33	
Social Class 3	11	22	8	
Unknown category (unemployed/students)	11	23	8	
Stay at home mothers	16	18	15	**0.000****
Parity				
Primi-parous mothers	49	42	51	
Multi-parous mothers	51	58	49	**0.146**
Planned/unplanned pregnancy				
Planned pregnancy	62	37	70	
Unplanned pregnancy	38	63	30	**0.000****
Mothers' reported pre-pregnancy BMI				
< 20 kg/m^2	10	15	9	
20-24.9 kg/m^2	56	46	59	
> 25 kg/m^2	34	39	32	**0.054**

[&] The univariate analyses compare the differences between the early and late weaning groups. The binary logistic regression analyses in **Table 7.15** to **7.17** will consider the statistical differences between the specific categories within the categorical variables

[+] Social class was based on occupation, see **Section 2.9** ****** significant, p<0.001

Table 7.2. Proportion of National Mothers who introduced solids prior to (≤) 12-weeks post partum by Fathers' socio-demographic characteristics

Fathers' socio-demographic characteristic	**Total sample of 368 partners** %	**Early Weaning Group (n = 91)** %	**Late Weaning Group (n = 309)** %	**Significance** *p value*
Partner status in total sample (n = 400)				
Partner present/involved in mothers life	92	86	94	
Partner absent/not involved in mothers life	8	14	6	**0.022***
Age group (yrs)		(n = 78)	(n = 290)	
≤ 24	13	22	10	
25-34	59	56	60	
≥ 35	28	22	30	**0.020***
Fathers' education level		(n = 78)	(n = 290)	
Primary & secondary	40	64	33	
Vocational/training course	31	30	32	
Third level degree/post-graduate	29	6	35	**0.000****
Paternal social class		(n = 78)	(n = 290)	
Social Class 1	36	13	42	
Social Class 2	8	5	9	
Social Class 3	50	76	43	
Unknown category (unemployed/students)	5	6	5	**0.000****

***** significant, $p<0.05$, ****** $p<0.001$

Table 7.3. Proportion of National Mothers who introduced solids prior to (≤) 12-weeks post partum by maternal health behaviours during pregnancy

Maternal health behaviours during pregnancy	**Total sample of 400 mothers** %	**Early Weaning Group (n = 91)** %	**Late Weaning Group (n = 309)** %	**Significance** *p value*
Smoking status				
Did not smoke during pregnancy	77	57	82	
Smoked during pregnancy	23	43	18	**0.000***
Alcohol consumption during pregnancy				
Alcohol consumed during pregnancy	38	43	36	
Alcohol not consumed during pregnancy	62	57	64	**0.308**

*****significant, $p<0.001$

7.4.2 Infant characteristics

Birth weight (*p = 0.01*) and size of infants at gestational age (*p = 0.017*) were both significantly associated with the timing of weaning, as summarized in **Table 7.4a**. In the early weaning group, a greater propensity towards infants born ≤ 2.99 kg was observed in 23% of infants, as well as those who were small for gestational age at birth (15%). Infants born > 4 kg were under represented in the early weaning group (10%) relative to the proportion of infants born > 4 kg in the total sample (16%). However, the majority of infants in the early weaning group were ‘appropriate for gestational age’ at birth (73%) and had a birth weight between 3-4 kg (67%). No differences were observed in terms of gender (*p = 0.63*) or gestational age at birth (*p=0.718*) and weaning ≤ 12-weeks or > 12-weeks.

The relationship between the timing of weaning (continuous variable, measured in weeks) and weight gain from birth 6-months (continuous variable, measured in kg) as investigated using the Pearson product-moment correlation coefficient revealed a non-significant (*p=0.137*) small negative correlation between the two variables (r = -0.145, n = 97). Similarly, a negative, non-significant correlation (*p=0.362*) was observed when the weight gain from birth to 6-weeks was analysed (r = -0.057, n = 234) (see **Table 7.4b**). These findings, although non-significant, indicate that infants who grew at a faster rate from birth to 6-weeks and from birth to 6-months were weaned earlier than those who exhibited a slower weight velocity.

Table 7.4a. Proportion of National Mothers who introduced solids prior to (≤) 12-weeks post partum by infant characteristics

Infant characteristic	**Total sample of 400 infants** %	**Early Weaning Group (n = 91)** %	**Late Weaning Group (n = 309)** %	**Significance** ***p value***
Gestational age at birth				
37 – 40 weeks gestational age at birth	42	40	42	
> 40 weeks gestational age at birth	58	60	58	**0.718**
Size of infant for gestational age				
Small for gestation	8	15	7	
Appropriate for gestation	75	73	75	
Large for gestation	17	12	18	**0.017***
Gender				
Males	55	53	56	
Females	45	47	44	**0.630**
Birth weight				
≤ 2.99 kg	15	23	12	
3 – 4 kg	69	67	70	
> 4 kg	16	10	18	**0.010***

***** significant, $p<0.05$

Table 7.4b. The relationship between infant weight gain from birth to 6-weeks and from birth to 6-months, weight at 6-weeks and timing of introduction to solids among infants for whom measurement data were available

Weight and weight gain	**Sample Size (n)**	**Pearson product moment correlation co-efficient (r value)[$]**	**Significance** ***p value***
Birth to 6-weeks*	234	- 0.057	**0.362**
6-week weight*	234	+ 0.03	**0.962**
Birth to 6-months^	97	- 0.145	**0.137**

* Of the 6-week anthropometric measurements: n = 125 weight measurements taken by the investigator in the hospital clinic, n = 83 weight measurements taken by the GP (reported by the mother) and n = 26 weight measurement taken by the public health nurse (reported by the mother)

^ Of the 6-month anthropometric measurements: n = 97 weight measurements were taken by the investigator

[$] Pearson product moment correlation co-efficient used for normally distributed data

7.4.3 Maternal employment factors

The results tabulated in **Table 7.5** highlight that mothers' working status at 6-months (full-time, part-time, not in employment) did not influence early weaning in this study (*p = 0.605*). There was, however, a non-significant trend towards mothers who returned to work ≤ 18 weeks (67%) and early weaning, compared to a third of mothers who weaned early (33%) and returned to work > 18 weeks (*p = 0.067*).

Table 7.5. Proportion of National Mothers who introduced solids prior to (≤) 12-weeks post partum by maternal employment factors

Mothers' employment status & related factors	**Total sample**	**Early Weaning Group (n = 91)**	**Late Weaning Group (n = 309)**	**Significance**
	%	**%**	**%**	***p value***
Timing of work return post partum	(n = 152)	(n = 36)	(n = 116)	
≤ 18 weeks post birth	52	67	47	
> 18 weeks post birth	48	33	53	**0.067**
Post partum employment status (at six months)	(n = 400)			
Working part-time	18	21	16	
Working full-time	20	19	21	
Mother not in employment	62	60	63	**0.605**
Infant attendance at a child minding facility/crèche during the first six months	(n = 400)			
Yes	38	40	37	
No	62	60	63	**0.821**

7.4.4 Ante and post natal care

As outlined in **Table 7.6a**, both mother and partner attendance at the antenatal classes at the point of recruitment (mean 35.18 wks ± SD 4.26) was significantly associated with weaning > 12-weeks (*p = 0.000*). Of relevance, the majority of mothers (70%) and partners (83%) who weaned early did not attend ante natal classes relative to the proportions expected in the total sample (51% and 63% of mothers and partners respectively). Similarly, among mothers > 30 weeks gestational age (n=334) (sub-analysis: **Table 7.6b**), a period beyond which mothers were likely to have commenced the ante natal classes (see **Section 7.3.3**), the majority of mothers in the late weaning group attended ante natal classes (58%) compared to the vast majority in the early weaning group who did not attend the classes (65%) (*p=0.001*). No difference was found in terms of number of ante natal classes attended by mothers *(p=0.641)* and early weaning in the total sample. Although all mothers had face-to-face contact with the public health nurse (PHN) during the first 6-weeks post partum (n = 400), the number of PHN follow-up visits during this time was not associated with weaning ≤ 12-weeks or > 12-weeks (*p=0.983*). Similarly, the acquisition of professional advice specifically regarding weaning information during the first 6-months did not appear to influence the timing of weaning (*p=0.119*).

Table 7.6a. Proportion of National Mothers who introduced solids prior to (≤) 12-weeks post partum by maternal antenatal and peri natal care

Ante natal & peri natal care	**Total sample** %	**Early Weaning Group (n = 91)** %	**Late Weaning Group (n = 309)** %	**Significance** *p value*
Mothers' attendance at ante natal classes during pregnancy at point of first interview ^	(n = 400)			
Attended ante natal classes	49	30	55	
Did not attend ante natal classes	51	70	45	**0.000***
No. of ante natal classes mother attended during pregnancy at point of first interview	(n = 198)	(n = 26)	(n = 172)	
1-3 ante natal classes attended	51	58	51	
≥ 4 ante natal classes attended	49	42	49	**0.641**
Partners' attendance at ante natal classes	(n = 368)	(n = 78)	(n = 290)	
Partner attends ante natal classes	37	17	43	
Partner does not attend ante natal classes	63	83	57	**0.000***
Professional advice sought by mothers during the first 6-months regarding weaning onto solids	(n = 400)			
Yes	59	52	61	
No	41	48	39	**0.119**
No. of contact points with the public health nurse during the first 6-weeks post partum	(n = 400)			
1-2 visits	49	48	49	
> 2 visits	51	52	51	**0.983**
No. of contact points with the GP ¥ during the first 6-weeks	(n = 400)			
Never seen the GP	34	43	31	
1-2 visits	59	49	62	
> 2 visits	7	8	7	**0.087**

^ mean gestational age of mothers (n =401) at ante natal recruitment = 35.18 wks ± SD 4.26 wks (min-max 24-42 wks)

¥ GP denotes the 'general practitioner'

***** significant, p<0.001

Table 7.6b. Association between ante natal class attendance and weaning period among Mothers > 30 weeks gestational age (n = 334)

Ante natal class attendance	Total sample	Early Weaning Group	Late Weaning Group	Significance
	%	%	%	*p value*
Mothers' ante natal class attendance	(n =334)	(n = 72)	(n = 262)	
Yes	53	35	58	
No	47	65	42	**0.001***
Partners' ante natal class attendance	(n = 309)	(n = 63)	(n = 246)	
Yes	38	21	42	
No	62	79	58	**0.003***

***** significant, $p<0.05$

7.4.5 Ante and post natal sources of infant feeding information

Mothers' infant feeding sources of information that were significantly and commonly associated with weaning ≤ 12-weeks and > 12-weeks ante natally (see **Table 7.7**), during the first 6-weeks (see **Table 7.8**) and from 6-weeks until 6-months (see **Table 7.9**) post partum included the 'maternal grandmother' (i.e. mother's own mother) and 'infant feeding books/infant-mother magazines'. In particular, almost two thirds of mothers (64%) reported the maternal grandmother as an ante natal infant feeding information source in the early weaning group, compared to 45% in the late weaning group, relative to what would be expected in the total sample (49%) ($p=0.002$). Likewise, of the mothers who weaned early, well over half of the sample reported the maternal grandmother as an infant feeding source of information during the first 6-weeks (56%) ($p=0.005$) and from 6-weeks until 6-months post partum (59%) ($p=0.000$). Of relevance, the PHN as an information source did not appear to influence weaning time during the first 6-weeks ($p=0.758$). However, from 6-weeks until 6-months the PHN was reported as a source of information on infant feeding by 27% of mothers and was identified as a key individual associated with weaning > 12-weeks (*p=0.002*) (see **Table 7.9**).

Non-public health infant feeding books and magazines featured as consistent and significant sources of infant feeding information by almost a third of mothers in the sample ante natally (33%), at 6-weeks (29%) and 6-months (33%) and were found to positively influence later weaning. Over a third of mothers (36%) who weaned > 12-weeks reported infant feeding books and magazines as an ante natal infant feeding information source compared to 20% of mothers in the early weaning group (*p=0.005*). Even more prominent as a strong influence on infant feeding among the mothers who weaned late, 39% reported infant feeding books/magazines as sources of feeding information on infant feeding from 6-weeks until 6-months compared to 12% of mothers who weaned early (*p=0.000*). Mothers' past experience with previous siblings did not appear to influence weaning time during the first 6-months (*p=0.123*).

These findings are further substantiated by the generally categorized sources of information on weaning as summarized in **Table 7.10.** Although non-significant (*p=0.191*), a greater proportion of mothers who weaned early reported their 'family (direct and indirect) and friends as a principal source of weaning information (42%) compared to 31% of mothers who weaned late. Similar to the trend observed, mothers who weaned early were significantly less likely to have reported a health professional (17%) (*p=0.028*) and weaning books (5%) (*p=0.000*) as a weaning information source compared to mothers who weaned >12-weeks. Further to these observations, a greater proportion of mothers who weaned early cited '*maternal instinct and common sense'* as a source of weaning information (7%), compared to fewer in the late weaning group (3%).

Table 7.7. Proportion of National Mothers who introduced solids by (≤) 12-weeks post partum by Mothers' ante natal infant feeding sources of information ¥

Ante natal infant feeding sources of information	Total sample of 400 mothers	Early Weaning Group (n = 91)	Late Weaning Group (n = 309)	Significance
	%	%	%	*p value*
Maternal grandmother	49	64	45	**0.002***
Infant feeding books/magazines	33	20	36	**0.005***
Friends	31	30	31	**0.901**
Ante natal classes	23	14	26	**0.031***
Midwives in the hospital	23	23	23	**1.000**
Sister	19	20	19	**1.000**
General practitioner	12	10	12	**0.659**
Public health nurse	10	9	10	**0.881**
Internet	8	4	8	**0.292**
Sister-in-law	7	6	7	**0.684**
Mother-in-law	5	7	4	**0.509**

***** significant, $p < 0.05$

¥ Data analysis was performed using the Chi-squared test and the Yates's Continuity Correction value

Table 7.8. Proportion of National Mothers who introduced solids by (≤) 12-weeks post partum by Mothers' postnatal sources of infant feeding information during the first 6-weeks ¥

Sources of infant feeding information during the first 6-weeks	Total sample of 400 mothers	Early Weaning Group (n = 91)	Late Weaning Group (n = 309)	Significance
	%	%	%	*p value*
Maternal grandmother	43	56	39	**0.005***
Infant feeding books/mother-infant magazines	29	19	32	**0.019***
Friends	18	12	20	**0.130**
Public health nurse	19	18	20	**0.758**
Sister	21	21	20	**1.000**
Ante natal classes	10	10	10	**1.000**
Internet	7	3	8	**0.209**
General practitioner	4	1	5	**0.162**
Mother-in-law	3	2	3	**0.999**

***** significant, $p < 0.05$

¥ Data analysis was performed using the Chi-squared test and the Yates's Continuity Correction value

Table 7.9. Proportion of National Mothers who introduced solids by (≤) 12-weeks by Mothers' postnatal sources of weaning information from 6-weeks until 6-months ¥

Sources of infant feeding information from 6-weeks until 6-months	Total sample of 400 mothers %	Early Weaning Group (n = 91) %	Late Weaning Group (n = 309) %	Significance *p value*
Weaning book/magazines	33	12	39	**0.000****
Past experience with other children	36	43	33	**0.123**
Maternal grandmother	38	59	31	**0.000****
Public health nurse	27	13	30	**0.002***
Friends	22	15	24	**0.112**
Sister	16	18	15	**0.702**
Commercial information	5	4	5	**1.000**
Mother-in-law	3	2	3	**0.872**
General practitioner	3	1	3	**0.465**

***** significant, $p<0.05$, ** $p<0.001$

¥ Data analysis was performed using the Chi-squared test and the Yates's Continuity Correction value

Table 7.10. Comparison of weaning sources of information between those who introduced solids ≤ 12-week versus > 12-weeks post partum†

Sources of weaning information	Early weaning group % of responses (n = 91)	Late weaning group % of responses (n = 309)	Significance *p value*
Family (direct + extended)/friends	42	31	**0.191**
Health professionals (public health nurse, midwives in hospital, general practitioner)	17	24	**0.028***
Past experience with previous children	16	12	**0.176**
Commercial information sources e.g. postal info., free samples, care lines	10	11	**0.468**
Maternal instinct/common sense/idea of 'reading the baby'/cues	7	3	**0.451**
Weaning books (non-public health material)	5	14	**0.000****
Media e.g. internet, television	2	4	**0.266**
Training/remember from school	1	1	**1.000**
Total	**100**	**100**	

***** significant, $p<0.05$, ** $p<0.001$

† The individual responses to mothers' sources of weaning information (e.g. sister, friend, public health nurse) were consolidated into specific categories as above, and analysed using the Chi-squared test and the Yates's Continuity Correction value

7.4.6 Feeding mode

Undoubtedly, the results of the study highlight that mothers who offered their infants 'any' breast milk during the first 12-weeks post partum were less likely to wean early (*p=0.000*). **Table 7.11** highlights that mothers who initiated breastfeeding (47% of the sample) were greatly under represented in the early weaning group (23%) and over represented in the late weaning group (54%) (*p=0.000*). Furthermore, mothers in the early weaning group were significantly (*p=0.000*) more likely to have formula fed at hospital discharge (87%), at 6-weeks (94%) and 12-weeks (97%) compared to mothers who offered 'any' breast milk to their infants.

Of major significance in this study, mothers' ante natal expected timing of weaning was significantly associated with the actual weaning time post partum (*p=0.000*). The majority of mothers (42%) who weaned early had ante natally planned to wean ≤ 12-weeks while a lower proportion of mothers who weaned late, had ante natally expected to wean ≤ 12-weeks (11%). Of the mothers in the late weaning group, the majority (51%) had ante natally expected to wean >17-weeks post partum *(p=0.000).* In addition, the relationship between the actual age of infants at weaning time and the age at which mothers ante natally expected to wean (two continuous variables) was explored using the Spearman correlation coefficient for non-parametric data, as illustrated in **Figure 7.1**. The analysis revealed a significant, positive correlation between the two variables, $r_s = 0.317$, n = 379, (*p=0.000)* indicating that later weaning was associated with later ante natal expectation of weaning time. Furthermore, the 'percentage of variance' (see **Section 7.3.4**) between the two variables yielded a variance of 10.04%, thus in the present study, mothers ante natal expectation of weaning time post partum helps to explain, or accounts for 10% of the variability in the timing of weaning post partum.

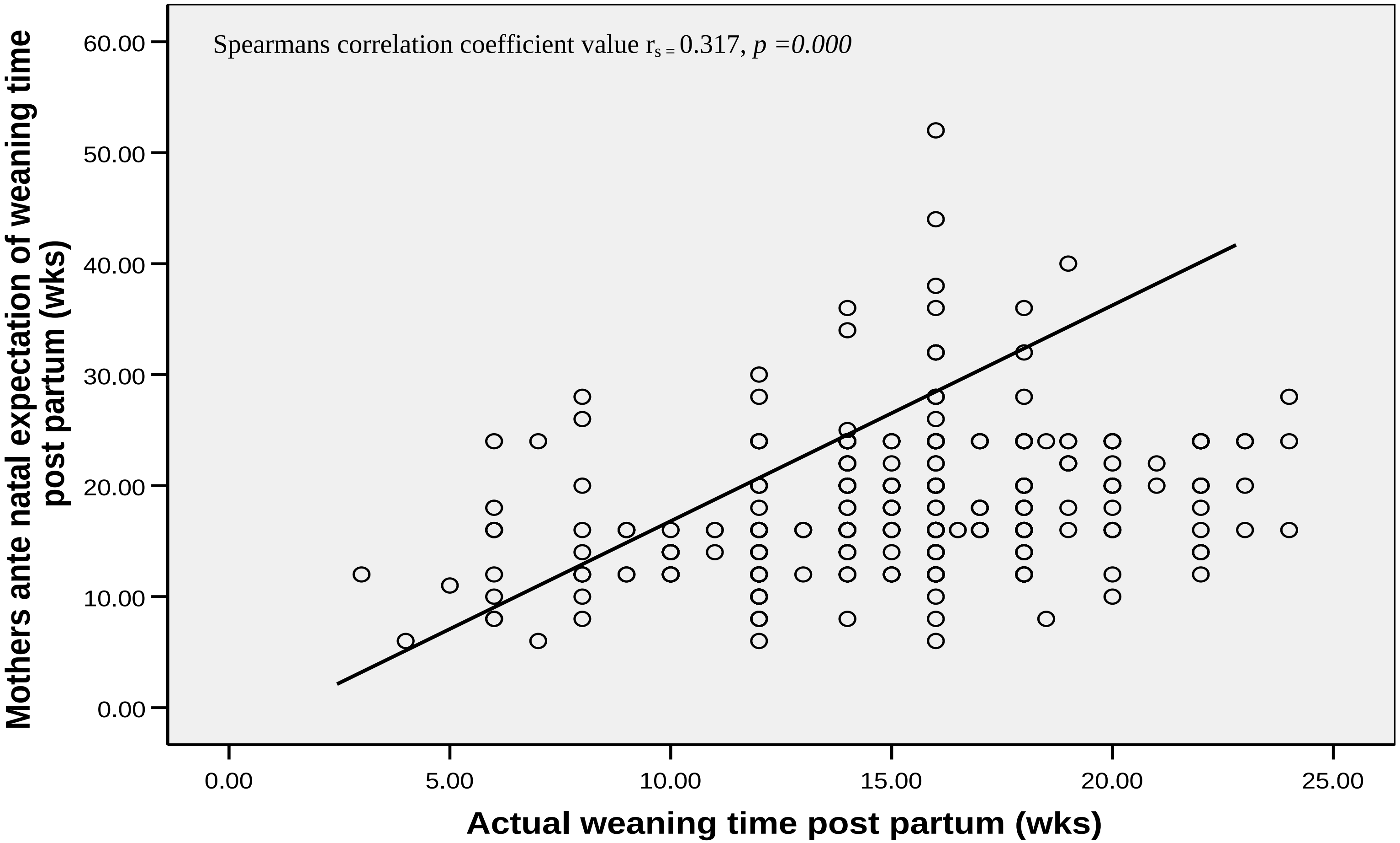
Table 7.11. Proportion of National Mothers who introduced solids by (≤) 12-weeks post partum by infant feeding characteristics

Infant feeding characteristic	Total sample of 400 mothers	Early Weaning Group (n = 91)	Late Weaning Group (n = 309)	Significance
	%	%	%	*p value*
Mothers who initiated breastfeeding				
Yes	47	23	54	
No	53	77	46	**0.000***
Mode of feeding at hospital discharge				
'Any' breastfeeding group	39	13	46	
Formula fed	61	87	54	**0.000***
Mode of feeding at 6-weeks post partum				
'Any' breastfeeding group	24	6	30	
Formula fed	76	94	70	**0.000***
Mode of feeding at 12-weeks post partum				
'Any' breastfeeding group	20	3	25	
Formula fed	80	97	75	**0.000***
Formula 'type' at 6-weeks post partum ^	(n = 340)	(n = 89)	(n = 251)	
Whey-based feed	60	40	67	
Casein-based feed	40	60	33	**0.000***
Ante natal expectation as to timing of weaning post partum				
Intended to introduce solids ≤ 12 wks	18	42	11	
Intended to introduce solids 13-17 wks	38	39	38	
Intended to introduce solids > 17 wks	44	19	51	**0.000***

^ Includes infants who were partially breastfed and formula fed

***** significant, p<0.001

Figure 7.1. Correlation between age of weaning and ante natal expectation of the weaning time post partum



7.4.7 Negative weaning practices

Significant associations were observed between mothers who carried out negative weaning practices such as the addition of inappropriate condiments to weaning foods (*p=0.000*) and those who offered their infants unsuitable snack foods *(p=0.000),* in relation to early weaning (see **Table 7.12**). Almost a third of mothers (32%) who weaned early offered inappropriate snacks to their infants compared to only 11% of mothers in the late weaning group (*p=0.000*). While 35% of the total sample reported adding unsuitable weaning mixers to the infant foods, almost two thirds of mothers (60%) who weaned early admitted to this practice compared to 28% of mothers who weaned late *(p=0.000).*

Table 7.12. Proportion of National Mothers who introduced solids by (≤) 12-weeks post partum by inappropriate weaning practices conducted by the Mother

Inappropriate weaning practices	**Total sample (n=400)** %	**Early Weaning Group (n = 91)** %	**Late Weaning Group (n = 309)** %	**Significance** *p value*
Additions of solids to infant feeds during first 6-months				
Yes	5	11	3	
No	95	89	97	**0.002***
Consuming inappropriate fluids (e.g. tea, carbonated drinks, water/sugar mixture)				
Yes	5	14	3	
No	95	86	97	**0.000****
Consuming inappropriate snack foods (e.g. chocolate, biscuits, ice-cream, crisps)				
Yes	16	32	11	
No	84	68	89	**0.000****
Addition of inappropriate condiments to weaning foods (e.g. gravy, sauces)				
Yes	35	60	28	
No	65	40	72	**0.000****

* significant, *p*<0.05, ** *p*<0.001

7.4.8 Maternal attitudes and perceptions

Table 7.13a highlights some of the reported reasons for initiating weaning during the first 6-months. Most significantly, mothers who reported that they initiated weaning owing to their perception that the baby was '*hungry*' and that introducing solid foods would '*help the baby to settle/sleep*' were more likely to wean early (*p=0.000*). In particular, over two thirds of mothers (67%) who weaned early reported '*infant hunger'* as the main reason for initiating weaning compared to 44% of mothers who weaned late. Interestingly, no statistical difference was found between mothers who reported 'infant hunger' as one of the reasons for initiating weaning and size for gestational age at birth (*p=0.501*) (see **Table 7.13b**). Although mothers with infants who were small for gestational age were more likely (*p=0.017*) to have weaned ≤ 12-weeks (15%) than what would be expected from the proportion in the total sample (8%) (see **Table 7.4a**), these mothers were not more likely to have reported 'infant hunger' as a reported reason for initiating weaning (*p=0.501*).

The generally coded reasons for initiating weaning, described in **Table 7.14** reveal that the main reason for initiating weaning among the vast majority in the early weaning group (58%) was due to the mother's perception of '*infant hunger'* compared to 47% in the late weaning group. It is relevant that 20% of mothers in the late weaning group adhered to infant feeding recommendations in relation to the timing of weaning, compared to no mother in the early weaning group.

Table 7.13a. Proportion of National Mothers who introduced solids by (≤) 12-weeks post partum by Mothers' reported reasons for introducing solids

Maternal reasons, perceptions and attitudes regarding the timing of weaning	**Total sample (n=400) %**	**Early Weaning Group (n = 91) %**	**Late Weaning Group (n = 309) %**	**Significance *p value***
Felt it was the 'right time'/mother led reasons				
Yes	11	17	9	
No	89	83	91	**0.069**
Maternal perception of infant hunger/perception that the baby was 'starving'				
Yes	49	67	44	
No	51	33	56	**0.000****
Maternal curiosity/'too see if he/she would take solids'				
Yes	3	3	3	
No	97	97	97	**1.000**
Habit/from experience with previous children				
Yes	6	9	5	
No	94	91	95	**0.192**
Mothers perception that the baby was a 'big baby' and needed more than formula/breast milk				
Yes	5	10	4	
No	95	90	96	**0.031***
To promote sleep/help to 'settle' the infant				
Yes	11	25	7	
No	89	75	93	**0.000****

*****significant, $p<0.05$, ** $p<0.001$

Table 7.13b. Relationship between the infants 'size for gestational age at birth' and Mothers reported reason for weaning being '*hunger*' or that the '*infant was starving all the time*' (sub-analysis)

Infant size for gestational age at birth	**Total sample of 400 infants (%)**	**Mothers reported reason for weaning: 'Infant hunger, or starving all the time'**	**Significance *p value***
Small for gestational age	8	7.6	
Appropriate for gestational age	75	73.6	
Large for gestational age	17	18.8	**0.501**

Table 7.14. Comparison of reasons as to why Mothers introduced solids in the early introduction to solids group (n = 91) and in the group who introduced solids > 12-weeks post partum (n = 309)

Reasons for introducing solids	Early weaning group % of responses (n = 91)	Late weaning group % of responses (n = 309)
Baby-led reasons e.g. hunger the main reason/starving all the time/high frequency of feeding/constantly feeding/waking up overnight/chewing fist, grabbing food (hunger cues evident)	58	47
Mother-led reasons e.g. mother felt it was the 'right time'/maternal curiosity 'to see if the baby would take solids'/felt the baby needed more than breast/formula milk/felt the baby was getting tired of bottles/mother wanted to establish a routine	19	19
Adhered to the infant feeding recommendations/health professionals advised mother to hold off till minimum of 17wks	0	20
Habit i.e. from previous experience with other children/family tradition	4	2
External/socially-related reasons e.g. work return as issue/crèche routine required the infant to have commenced solids/felt pressure from friends & family to start solids/followed the practices of friends	3	4
Reasons related to weaning process e.g. wanted to get the baby used to taking a spoon/to 'prevent faddy' eating later on	1	1
To reduce the severity of conditions e.g. lactose intolerance, constipation, reflux problems, allergy risk	1	3
Perception that introducing solids would improve conditions e.g. colic, reflux, constipation, poor weight gain	4	1
Perception that introducing solids would promote sleep/help the baby to settle	10	3
Total	**100**	**100**

7.4.9 Independent predictors of early weaning

After controlling for the main confounding variables including mother's age, education, parity, smoking status during pregnancy, birth weight and gestational age at birth in the multivariate analyses, as shown in **Table 7.15,** final socio-demographic (see **Table 7.16**) and attitudinal and psychosocial (see **Table 7.17**) binary logistic regression models were constructed.

The socio-demographic model, which was indicated as being 82.3% predictive, highlighted maternal education as being a major determinant of early weaning, even after adjusting for the aforementioned confounding variables. Mothers who completed education to primary or secondary school level were over 6 times more likely (OR 6.78, CI 2.32–19.77) to wean early compared to mothers who completed their education to third level ($p=0.000$). Ante natal expectation as to the timing of weaning post partum was also highlighted as an independent predictor of early weaning ($p=0.000$) with mothers being over 7 times more likely (OR 7.33, CI 3.17 – 16.95) to wean early if they ante natally expected to wean ≤ 12-weeks compared to > 17-weeks. Mothers who reported the maternal grandmother as an infant feeding information source from 6-weeks until 6-months were over twice as likely (OR 2.26, CI 1.21 – 4.25) to wean early ($p=0.011$) while mothers who reported the PHN as an information source were 70% less likely to wean early (OR 0.304, CI 0.135 – 0.682) ($p = 0.004$). Feeding mode was also highlighted as a significant independent predictor of early weaning with formula feeding mothers at 12-weeks post partum being almost 4 times (OR 3.91, CI 1.06 – 14.4) more likely to wean early compared to mothers who were offering their infants any breast milk ($p=0.04$). Although a significant association was found between smoking and early weaning in the univariate analysis ($p=0.000$), after adjustment, smoking was not found to be a significant predictor of early weaning ($p=0.692$).

The attitudinal and psychosocial model was indicated as being 84.2% predictive, highlighting maternal education to primary/secondary school level (*p=0.001*) and younger mothers ≤ 24 years (*p=0.006*) as being more likely to wean early. Specific maternal reasons for introducing solids were found to be independently predictive of early weaning. In particular, mothers who reported that they initiated weaning as a result of '*infant hunger'* were over 3 times more likely (OR 3.31, CI 1.77 – 6.19) to wean early (*p=0.000*) as well as mothers who perceived their infants as being a '*big baby'* (OR 6.04, CI 1.67 – 21.8). Similarly, mothers who reported that they initiated weaning 'to help to promote infant sleep' or 'to help the baby to settle' were almost 5 times more likely to wean early (OR 4.85, CI 2.07 – 11.37) (*p = 0.000*). The prevalence of all inappropriate weaning practices were found to be significantly associated with early weaning in the univariate analyses, as well as being independently predictive of early weaning in the multivariate model. Mothers who added solid foods to infant feeds were almost 5 times more likely (OR 4.89, CI 1.26 – 18.98) to wean early compared to mothers who did not conduct this practice (*p = 0.022*), even after adjusting for confounding factors.

Table 7.15. The relationship of each of the individual categorical variables to the early introduction of solid food (≤ 12-weeks), as assessed by binary logistic regression

Mothers who introduced solids early (≤ 12-weeks) versus those who introduced > 12-weeks post partum						
	Univariate			**Multivariate***		
	ß	**Sig.**	**Odds Ratio**	**ß**	**Sig.**	**Odds Ratio**
Mothers' age group (yrs)						
≥ 35 ^		0.000			0.006	
25-34	+	0.018	2.92	+	0.013	3.339
≤ 24	+	0.000	7.0	+	0.001	5.481
Health insurance status						
Private ^		0.000			0.113	
Public	+	0.000	9.71	+	0.083	3.13
Semi-private	+	0.109	2.79	+	0.337	1.9
Marital status						
Married ^		0.000			0.031	
Unmarried	+	0.000	4.8	+	0.01	2.4
Single	+	0.000	6.64	+	0.59	2.35
Mothers' education level						
Third level degree/post graduate ^		0.000			0.000	
Primary & secondary level	+	0.000	10.97	+	0.000	7.26
Vocational/training course	+	0.000	6.38	+	0.001	4.75
Mothers' social class						
Social Class 1 ^		0.000			0.039	
Social Class 2	+	0.068	2.0	-	0.512	0.74
Social Class 3	+	0.000	7.11	+	0.230	1.83
Unknown category	+	0.000	7.77	+	0.313	1.69
Stay at home mothers	+	0.000	3.21	-	0.287	0.56
Parity						
Primi-parous mothers ^						
Multi-parous mothers	+	0.117	1.45	+	0.034	1.862
Planned/unplanned pregnancy						
Planned pregnancy ^						
Unplanned pregnancy	+	0.000	3.83	+	0.007	2.25
Partner status						
Partner present in mothers life ^						
Partner absent	+	0.014	2.54	-	0.986	0.99
Fathers' age group (yrs)						
≥ 35 ^		0.024			0.212	
≤ 24	+	0.009	2.86	-	0.138	0.4
25-34	+	0.434	1.27	-	0.094	0.5

	ß	Sig.	OR	ß	Sig.	OR
Fathers' education level						
Third level degree/post-graduate ^		0.000			0.056	
Primary & secondary level	+	0.000	10.41	+	0.017	3.6
Vocational/training Course	+	0.002	5.05	+	0.056	2.8
Paternal social class						
Social Class 1 ^		0.000			0.211	
Social Class 2	+	0.346	1.8	+	0.686	1.32
Social Class 3	+	0.000	5.71	+	0.087	2.02
Unknown category (unemployed/students)	+	0.022	4.06	-	0.924	0.93
Smoking status during pregnancy						
Did not smoke during pregnancy ^						
Smoked during pregnancy	+	0.000	3.54	+	0.053	1.78
Mothers' employment status post partum						
Not in employment ^		0.606			0.300	
Working part-time	+	0.386	1.307	+	0.168	1.614
Working full-time	-	0.784	0.918	+	0.286	1.468
Timing of work return post partum						
> 18 weeks post birth ^						
≤ 18 weeks post birth	+	0.046	2.21	+	0.76	1.15
Gestational age at birth						
37 – 40 wks gestational age at birth ^						
> 40 wks gestational age at birth	+	0.63	1.12	+	0.179	1.496
Size of infant for gestational age						
Large for gestation ^		0.021			0.688	
Small for gestation	+	0.008	3.56	-	0.874	0.87
Appropriate for gestation	+	0.307	1.44	-	0.492	0.64
Birth weight						
> 4 kg ^		0.012			0.229	
≤ 2.99 kg	+	0.005	3.59	+	0.148	2.15
3 – 4 kg	+	0.13	1.79	+	0.700	1.17
Mothers' attendance at ante natal classes during pregnancy at point of interview						
Attended ante natal classes ^						
Didn't attend ante natal classes	+	0.000	2.93	+	0.17	1.5
Partners' attendance at ante natal classes						
Partner attends ante natal classes ^						
Partner didn't attend ante natal classes	+	0.000	3.72	+	0.008	2.64
Principal ante-natal infant feeding sources of information						
Maternal grandmother	+	0.002	2.15	+	0.976	1.0
Ante natal classes	-	0.023	0.47	+	0.996	0.99
Books/magazines	-	0.004	0.43	-	0.153	0.63
Internet	-	0.209	0.5	+	0.87	1.1
Principal infant feeding information sources post natally during first 6-wks						
Maternal grandmother	+	0.004	2.0	+	0.601	1.15
Books/magazines (non-public health literature)	-	0.015	0.48	-	0.857	0.94

	ß	Sig.	OR	ß	Sig.	OR
Principal weaning information sources during the first 6-months						
Maternal grandmother	+	0.000	3.23	+	0.002	2.39
Weaning book/magazine (non-public health lit.)	-	0.000	0.21	-	0.095	0.53
Public health nurse	-	0.002	0.34	-	0.002	0.32
Mothers who initiated breastfeeding						
Yes ^						
No	+	0.000	3.92	+	0.034	1.92
Mode of feeding at 12-weeks post partum						
'Any' breastfeeding group ^						
Formula fed	+	0.000	9.73	+	0.023	4.15
Formula type at six-weeks						
Whey-based feed ^						
Casein-based feed	+	0.000	2.98	+	0.001	2.48
Ante natal expectation as to timing of solid introduction post partum						
Intended to introduce solids > 17 wks ^		0.000			0.000	
Intended to introduce solids ≤ 12 wks	+	0.000	10.32	+	0.000	7.75
Intended to introduce solids 13-17 wks	+	0.002	2.78	+	0.016	2.37
Ante natal expectation as to timing of solid introduction post partum						
Intended to introduce > 17 wks ^						
Intended to introduce ≤ 17 wks	+	0.000	4.45	+	0.000	3.53
Additions of solids to infant feeds during first 6-months						
No ^						
Yes	+	0.002	4.64	+	0.038	3.22
Consuming glucose/sugar and water as a fluid other than breast/formula milk						
No ^						
Yes	+	0.002	5.57	+	0.015	4.44
Consuming carbonated drinks (e.g. 7-up, diet coke) as a fluid other than breast/formula milk						
No ^						
Yes	+	0.011	18.05	+	0.175	5.4
Consuming tea as a fluid other than breast/formula milk						
No ^						
Yes	+	0.028	12.94	+	0.287	3.89
Maternal reported reasons for introducing solids:						
Felt it was the 'right time'/mother led reasons	+	0.048	1.98	+	0.041	2.25
Hunger was the main reason/perception that the baby was 'starving'	+	0.000	2.58	+	0.000	3.01
Maternal curiosity/'too see if baby would take solids	+	0.85	1.13	+	0.687	1.35
Habit/from experience with previous children	+	0.124	2.03			
Mothers perception that the baby was a 'big baby'				+	0.358	1.63
and needed more than formula/breast milk	+	0.019	2.97	+	0.02	3.93
To promote sleep/help to 'settle' the infant	+	0.000	4.63	+	0.000	4.28

***** Controlling for the confounding variables including:
maternal education level, age, smoking status, birth weight & gestational age of infant at birth
^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

Table 7.16. Final multiple binary logistic regression model examining the effect of socio-demographic factors on predicting early weaning*

Model 1: Socio demographic model (-2LL= 278; R^2 =0.3; 82.3% predictive)	ß	Sig.	OR	95% C.I. Lower	95% C.I. Upper
Mothers' education level					
Third level degree/post-graduate ^		0.002			
Primary & secondary level	+	0.000	6.78	2.32	19.77
Vocational/training course	+	0.005	4.93	1.61	15.1
Mothers' age group (yrs)					
≥ 35 ^		0.055			
≤ 24	+	0.018	4.51	1.29	15.78
25-34	+	0.026	3.57	1.16	10.94
Parity					
Primi-parous mothers ^					
Multi-parous mothers	+	0.248	1.51	0.74	3.07
Smoking status					
Did not smoke during pregnancy ^					
Smoked during pregnancy	+	0.692	1.15	0.56	2.36
Infant birth weight					
> 4 kg ^		0.072			
≤ 2.99 kg	+	0.287	1.73	0.63	4.74
3 – 4 kg	-	0.604	0.76	0.27	2.11
Gestational age at birth					
37 – 40 wks gestational age at birth ^					
> 40 wks gestational age at birth	+	0.056	1.92	0.98	3.76
Mode of feeding at 12-wks post partum					
'Any' breastfeeding at 12-wks^					
Formula feeding at 12-wks	+	0.04	3.91	1.06	14.4
Ante natal expectation of timing of introduction to solids post partum					
Introduce > 17 wks^		0.000			
Introduce ≤ 12 wks	+	0.000	7.33	3.17	16.95
Introduce 13-17 wks	+	0.039	2.19	1.04	4.61
Mothers' principal sources of information on weaning from 6-weeks to 6-months					
Reported the maternal grandmother as main source of weaning information	+	0.011	2.26	1.21	4.25
Reported the public health nurse as main source of weaning information	-	0.004	0.304	0.135	0.682

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

***** Model controls for confounding variables including: maternal education level, age, parity, smoking status, infant birth weight and gestational age of infant at birth

Table 7.17. Final multiple binary logistic regression model examining the effect of attitudinal and psychosocial factors on predicting early weaning*

Model 2: Attitudinal & psychosocial model (-2LL= 269; R^2 =0.32; 84.2% predictive)	ß	Sig.	OR	95% C.I. Lower	95% C.I. Upper
Mothers' education level					
Primary degree/post graduate ^		0.003			
Primary & secondary	+	0.001	5.9	2.06	16.87
Vocational/training course	+	0.025	3.4	1.16	10.28
Mothers' age group (yrs)					
≥ 35 ^		0.022			
≤ 24	+	0.006	6.28	1.67	23.57
25-34	+	0.012	4.7	1.41	15.62
Parity					
Primi-parous mothers ^					
Multi-parous mothers	+	0.165	1.64	0.81	3.33
Smoking status					
Did not smoke during pregnancy ^					
Smoked during pregnancy	+	0.236	1.54	0.75	3.18
Infant birth weight					
> 4 kg ^		0.083			
≤ 2.99 kg	+	0.086	2.64	0.87	8.02
3 – 4 kg	+	0.657	1.28	0.43	3.81
Gestational age at birth					
37 – 40 wks gestational age at birth ^					
> 40 wks gestational age at birth	+	0.153	1.65	0.83	3.28
Mothers who add solid food to infant feeds during the first six months					
No additions to infant feeds ^					
Additions to infant feeds	+	0.022	4.89	1.26	18.98
Ante natal expectation of timing of introduction to solids post partum					
Introduce > 17 wks ^					
Introduce ≤ 17 wks	+	0.000	5.2	2.41	11.21
Mothers reasons for introduction to solids					
'Help infant to sleep better/settle quicker'					
Didn't report this reason^					
Reported this reason	+	0.000	4.85	2.07	11.37
'Infant was a big baby so felt he/she needed more than just formula/breast milk'					
Didn't report this reason^					
Reported this reason	+	0.006	6.04	1.67	21.8
' Hunger was the main reason/starving infant'					
Didn't report this reason^					
Reported this reason	+	0.000	3.31	1.77	6.19

^ denotes the reference category ß = Beta co-efficient Sig. = Significance value OR = Odds Ratio

***** Model controls for confounding variables including: maternal education level, age, parity, smoking status, infant birth weight and gestational age of infant at birth

7.4.10 Characteristics of the mothers who performed inappropriate weaning practices

A greater propensity towards the provision of unsuitable snack foods was prevalent among mothers ≤ 24 years of age (46%), who had public health insurance during pregnancy (81%) and who had an educational attainment level to primary/secondary school level (75%) (*p=0.000*) (see **Table 7.18**). Parameters of lower socio-economic status were equally evident among mothers who added unsuitable condiments to the weaning foods with over half of the mothers (54%) educated to primary/secondary level and over two thirds having public health insurance during pregnancy (68%) (*p=0.000*). A greater proportion of mothers who were unemployed or students (unknown category) offered unsuitable snacks to their infants (33%) and added condiments to the weaning foods (21%) relative to the proportion in the sample (11%) (*p=0.000*). Few mothers in Social Class 1 provided such snacks to their infants (8%) and added condiments to the weaning foods (18%) relative to the proportion in the sample (31%). Parity, gender and gestational age of the infants at birth were not associated with the occurrence of negative weaning practices. However, as shown in **Table 7.19**, a significant association was observed between poor weaning practices and a greater preponderance of infants who were small for gestational age and born ≤ 2.99kg. In particular, almost a quarter of infants (22%) born ≤ 2.99kg were offered unsuitable snacks relative to the expected proportion in the sample (15%), compared to only 6% of infants who were born >4kg (*p=0.02*).

Table 7.20 highlights that mothers who were not in employment at 6-months (*p=0.022*) and infants who did not attend a child minding facility/crèche (*p=0.035*) were significantly more likely to be in the inappropriate snacking group. Among the working mothers, timing of work return was not significantly associated with the conduction of negative weaning practices. The vast majority of mothers in the inappropriate snacking group did not initiate breastfeeding (75%) (*p=0.000*) and were formula feeding at 6-weeks (89%) (*p=0.013*) (see **Table 7.21**). Results also highlight that mothers who added condiments to the weaning foods (35%) were significantly more likely to provide unsuitable snacks to their infants (67%) (*p=0.000*) and were more likely to wean ≤ 12-weeks post partum (39%) (*p=0.000*).

Table 7.22 considers the sources of weaning information of mothers who conducted negative weaning practices. It is relevant that no significant differences were observed between mothers who received professional weaning advice/information and the provision of unsuitable snacks to infants (*p=0.817*) or additions of condiments to the weaning foods (*p=0.198*). Although 85% of the total sample reported satisfaction with the professional advice received, this did not appear to influence the high prevalence of inappropriate weaning practices. The influence of the maternal grandmothers was further highlighted in these results, with the majority of mothers in the inappropriate snacking group (56%) reporting the maternal grandmother as a significant source of weaning information (*p=0.002*). Mothers who reported '*common sense'* as a weaning information source (4%) were significantly over-represented in the inappropriate snacking group (11%) (*p=0.005*); however, no significant association was observed between those who reported '*common sense*' as a weaning information source and those who added unsuitable condiments to the weaning foods (*p=0.321*).

Table 7.18. Social and demographic characteristics of National Mothers who conducted inappropriate weaning practices during the first 6-months†

Socio-demographic characteristic	Total sample (n = 400)	% of mothers who added unsuitable condiments to weaning foods & (n = 141)		% of mothers offering inappropriate snacks$ (n = 63)	
	%	%	*p value*	%	*p value*
Age group (yrs)					
≤ 24	22	36		46	
25-34	60	55		51	
≥ 35	18	9	**0.000****	3	**0.000****
Health insurance status during pregnancy					
Public	49	68		81	
Semi-private	37	23		16	
Private	14	9	**0.000****	3	**0.000****
Mothers' education level					
Primary & secondary school	40	54		75	
Vocational/training course	29	29		17	
Third level degree/post-graduate	31	17	**0.000****	8	**0.000****
Marital status					
Married (living/not living with husband)	59	43		24	
Unmarried (living/not living with partner)	31	40		47	
Single (living alone/living with parents)	10	17	**0.000****	29	**0.000****
Partner status					
Partner present/involved in mothers life	92	87		79	
Partner absent/not involved in mothers life	8	13	**0.016***	21	**0.000****

Table 7.18 continued **Socio-demographic characteristic**	**Total sample (n = 400)** **%**	**% of mothers who added unsuitable condiments to weaning foods [&] (n = 141)** **%**	***p value***	**% of mothers offering inappropriate snacks[$] (n = 63)** **%**	***p value***
Fathers' education level	(n = 368)	(n = 123)		(n = 50)	
Primary & secondary school	40	52		64	
Vocational/training course	31	29		24	
Primary degree/post-graduate	29	19	**0.001***	12	**0.001***
Home arrangement					
Home owner	73	60		48	
Non-home owner	27	40	**0.000****	52	**0.000****
Maternal Social Class					
Social Class 1	31	18		8	
Social Class 2	31	23		22	
Social Class 3	11	16		13	
Unknown Category (unemployed/students)	11	21		33	
Stay at home mothers/home-maker	16	21	**0.000****	24	**0.000****
Paternal Social Class	(n = 368)	(n = 123)		(n = 50)	
Social Class 1	36	25		16	
Social Class 2	8	9		6	
Social Class 3	50	59		66	
Unknown Category (unemployed/students)	5	7	**0.011***	12	**0.003***
Parity					
Primi-parous mothers	49	46		52	
Multi-parous mothers	51	54	**0.452**	48	**0.654**
Maternal health behaviour					
Smoking status					
Did not smoke during pregnancy	77	64		46	
Smoked during pregnancy	23	36	**0.000****	54	**0.000****

[&] includes gravy, butter, sauces, sugar/honey, vegetable stock, baby gravy & table salt [$] includes crisps, chocolate, biscuits, cake & ice-cream ***significant, p<0.05 ***p<0.001

[†] Data analysis was performed using the Chi-squared test to examine the relationship between the categorical variables among those who performed the inappropriate weaning practices presented, and those who did not.

Table 7.19. Characteristics of the infants born to National Mothers who conducted inappropriate weaning practices during the first 6-months†

Infant characteristics	**Total sample (n = 400)**	**% of mothers who added unsuitable condiments& to weaning foods (n = 141)**	***p value***	**% of mothers offering inappropriate snacks$ (n = 63)**	***p value***
Gestational age at birth					
37 – 40 weeks gestational age at birth	42	43		40	
> 40 weeks gestational age at birth	58	57	**0.893**	60	**0.823**
Size of infant for gestational age					
Small for gestation	8	14		14	
Appropriate for gestation	75	73		76	
Large for gestation	17	13	**0.020***	10	**0.071**
Gender					
Males	55	57		51	
Females	45	43	**0.636**	49	**0.496**
Birth weight					
≤ 2.99 kg	15	21		22	
3 – 4 kg	69	66		72	
> 4 kg	16	13	**0.030***	6	**0.020***

& includes gravy, butter, sauces, sugar/honey, vegetable stock, baby gravy & table salt $ includes crisps, chocolate, biscuits, cake & ice-cream *****significant, *p*<0.05

† Data analysis was performed using the Chi-squared test to examine the relationship between the categorical variables among those added unsuitable condiments to the weaning foods versus those who did not, as well as those who offered inappropriate snacks to their infants versus those who did not.

Table 7.20. Employer-related characteristics of National Mothers who conducted inappropriate weaning practices during the first 6-months[†]

Mothers' employment status & related factors	Total sample	% of mothers who added unsuitable condiments[&] to weaning foods (n = 141)	*p value*	% of mothers offering inappropriate snacks[$] (n = 63)	*p value*
Mothers' employment status at 6-months post partum	(n = 400)				
Mother not in employment	62	67		75	
Part-time	18	15		17	
Full-time	20	18	**0.357**	8	**0.022***
Timing of actual work return post partum	(n = 152)	(n = 47)		(n = 16)	
≤ 18 weeks post birth	52	51		69	
> 18 weeks post birth	48	49	**1.000**	31	**0.248**
Infants attendance to a crèche/child minding facility outside the home	(n = 400)				
Yes	38	33		25	
No	62	67	**0.190**	75	**0.035***

[&] includes gravy, butter, sauces, sugar/honey, vegetable stock, baby gravy & table salt [$] includes crisps, chocolate, biscuits, cake & ice-cream ***significant, p<0.05

[†] Data analysis was performed using the Chi-squared test to examine the relationship between the categorical variables among those added unsuitable condiments to the weaning foods versus those who did not, as well as those who offered inappropriate snacks to their infants versus those who did not.

Table 7.21. Infant feeding-related characteristics of the National Mothers who conducted inappropriate weaning practices during the first 6-months †

Infant feeding characteristics	Total sample (n = 400)	% of mothers who added unsuitable condiments[&] to weaning foods (n = 141)	*p value*	% of mothers offering inappropriate snacks[$] (n=63)	*p value*
Initiation of breastfeeding					
Yes	47	32		25	
No	53	68	**0.000****	75	**0.000****
Feeding status at 6-weeks					
'Any' breastfeeding	24	12		11	
Formula/cows milk feeding	76	88	**0.000****	89	**0.013***
Introduction to solids					
≤ 12-weeks post partum	23	39		46	
> 12-weeks post partum	77	61	**0.000****	54	**0.000****
Mothers who offer inappropriate snacks					
Yes	16	30			
No	84	70	**0.000****	**n/a**	**n/a**
Mothers who add inappropriate mixers to weaning foods (e.g. salt, gravy)					
Yes	35			67	
No	65	**n/a**	**n/a**	33	**0.000****

[&] includes gravy, butter, sauces, sugar/honey, vegetable stock, baby gravy & table salt [$] includes crisps, chocolate, biscuits, cake & ice-cream *****significant, $p<0.05$, **$p<0.001$

† Data analysis was performed using the Chi-squared test to examine the relationship between the categorical variables among those added unsuitable condiments to the weaning foods versus those who did not, as well as those who offered inappropriate snacks to their infants versus those who did not.

Table 7.22. Sources of weaning information in National Mothers who conducted inappropriate weaning practices during the first 6-months†

Sources of infant feeding information	Total sample (n = 400)	% of mothers who added unsuitable condiments& (n = 141)	*p value*	% of mothers offering inappropriate snacks$ (n=63)	*p value*
Mothers who received professional advice on weaning during the first 6-months					
Yes	59	55		57	
No	41	45	**0.198**	43	**0.817**
Mothers satisfaction with the professional weaning information/advice received					
Yes	85	89		92	
No	15	11	**0.205**	8	**0.142**
Weaning advice source: Public Health Nurse					
Yes	27	26		19	
No	73	74	**1.000**	81	**0.192**
Weaning advice source: Maternal grandmother					
Yes	38	51		56	
No	62	49	**0.000****	44	**0.002***
Weaning advice source: '*Common sense*'					
Yes	4	6		11	
No	96	94	**0.321**	89	**0.005***
Weaning advice source: Weaning book/magazine					
Yes	33	22		9	
No	67	78	**0.001***	91	**0.000****
Weaning advice source: Internet					
Yes	10	5		6	
No	90	95	**0.016***	94	**0.376**

& includes gravy, butter, sauces, sugar/honey, vegetable stock, baby gravy & table salt $ includes crisps, chocolate, biscuits, cake & ice-cream   *****significant, $p<0.05$, **$p<0.001$

† Data analysis was performed using the Chi-squared test to examine the relationship between the categorical variables among those added unsuitable condiments to the weaning foods versus those who did not, as well as those who offered inappropriate snacks to their infants versus those who did not.

7.5 Discussion

Significant deviations from current weaning recommendations were demonstrated in the present study, which indicated a need to better understand why such sub-optimal infant feeding practices occurred. A finding that alerted particular concern in this study was the fact that 23% of infants were weaned by 12-weeks post partum (see **Figure 6.4**). Although this indicates an improvement from previous national studies (McSweeney & Keveny, 1982; Freeman, 1996; Twomey *et al.,* 2000), early weaning among mothers in Dublin remains a public health concern.

Consistent with the literature (Kajosaari & Saarinen, 1983; Forsyth *et al.,* 1993; Alder *et al.,* 2004; Morgan *et al.,* 2004a; Wright *et al.,* 2004), premature weaning ≤ 12-weeks was chosen as the early weaning marker in this investigation, which incorporated a study population that consisted of a large sample size for data analysis (n = 91). Moreover, early weaning ≤ 12-weeks (Kajosaari, 1991), ≤ 15-weeks (Wilson *et al.,* 1998) and ≤ 16-weeks (Fergusson *et al.,* 1990) has been associated with long and short-term deleterious health effects. The use of 16-weeks as an early weaning cut off mark would not have been ideal in this study, as the vast majority of mothers had weaned by this time point (70.5%).

Factors affecting premature weaning ≤ 12-weeks

There are many influences on the process of weaning to which culture, taboos, religious beliefs, ethnicity, tradition, medical opinion and dietary fads all contribute (Davies & O'Hare, 2004). Quantitative and qualitative research indicates that the timing of introduction to solids is influenced by an inter-related paradigm consisting of psychosocial, anthropometrical and socio-demographic variables. In agreement with current evidence (Foster *et al.,* 1997; Dubois & Girard, 2003b), our results emphasize that a strong socio-economic gradient is associated with early weaning. In conflict with previous Irish research showing that social class was unrelated to weaning prior to 8 weeks (Twomey *et al.,* 2000), our findings show that a greater proportion of single (21%), younger mothers ≤ 24 years of age (38%) who were in Social Class 3 (22%) weaned prematurely compared to what would be expected (*p=0.000*) (see **Table 7.1**). The fact that maternal age and education were found to be consistent determinants of early weaning among mothers in Dublin places a strong focus on the socio-cultural environment. These results concur with previous Scottish research showing that 31% of mothers from Social Class 3 weaned < 10 weeks, compared to 9% of mothers from Social Class 1 and 2 (Savage *et al.*, 1998). In another Scottish study consisting of 671 mothers, lower maternal social class was also identified as a principal predictor of early weaning (Forsyth *et al.*, 1993). In keeping with results from the UK National Infant Feeding Survey 2000 (Hamlyn *et al.*, 2002), our findings show that the vast majority of infants who were weaned early had fathers who were in Social Class 3 (76%) relative to what would be expected (50%) (*p=0.000*), thus further highlighting the role of parental socio-demographic influences in determining early weaning. However, after adjusting for a number of confounding variables[†] in the multivariate analysis, paternal social class was not significantly associated with early weaning (*p=0.211*), although the significant influence of maternal social class remained (*p=0.039*). It is possible that mothers from higher social classes may have more money available to spend on good quality food and may be more knowledgeable about nutrition (Earland *et al.*, 1997). Other researchers have found that younger mothers wean earlier than their older counterparts (Savage *et al.*, 1998; Norris *et al.*, 2002). Bentley *et al.*, (1999) suggested that younger mothers often face multiple barriers and challenges such as being unprepared for parental responsibility, lacking experience, and depending on guardians for financial support. In addition, mothers from lower socio-economic groups tend to smoke during pregnancy

[†] Confounding variables that were included in the final multivariate models included: maternal age, education, parity, smoking status, gestational age of infant at birth and birth weight

(Delpisheh *et al.,* 2006), be unmarried (Franz *et al.,* 2003), younger and less educated (CSO, 2006) and less confident (Andreozzi *et al.,* 2002), so are likely to depend on family and friends for advice and support, and less likely to go against their wishes and traditions (Garcia Coll *et al.,* 1987). To further compound these issues, young maternal age has been associated with low parenting confidence, high parent stress and low child acceptance (East *et al.,* 1994).

Comparable with existing data (Kwavnick *et al.,* 1999; Hendricks *et al.,* 2006), maternal educational attainment level was confirmed as being hugely influential on early weaning with a greater proportion of mothers who weaned early completing education to primary or secondary school level (63%) compared to only 7% who had a third level educational attainment level (*p=0.000*). Regardless of the variables inputted into the final logistic regression models, maternal education remained a strong independent predictor of early weaning both in the socio-demographic (*p=0.002*) and attitudinal and psychosocial model (*p=0.003*); mothers who completed education to primary/secondary level were almost 7 times more likely to wean early (OR 6.78, CI 2.32-19.77) than those in the higher education bracket. Similarly, in a Swedish study (n = 506), Hornell *et al.,* (2001) showed that mothers without a university education (41%) were more likely to wean their infants < 4 months than those with a university education (31%) (*p=0.047*). A significant linear trend of increasing odds was found between the timing of introduction to solids and increasing maternal age, education and degree of urbanization in a sample of 2,383 Norwegian mothers (Lande *et al.,* 2003). In a USA report, having a third level college education was associated with more positive infant feeding behaviours than any other maternal characteristic (Hendricks *et al.,* 2006). It is possible that mothers who are better educated have different priorities and higher levels of self-esteem, resulting in greater efforts to comply with feeding recommendations. Additionally, mothers with higher educational attainment levels may have a better understanding of the deleterious consequences associated with sub-optimal practices or may have a family and social network that share similar attitudes to infant feeding thus strengthening and supporting their own beliefs and practices. This is substantiated by a finding found in this study (see **Chapter 5)** in that mothers who initiated breastfeeding were more likely to have reported that 'most or some' of their friends breastfed (78%) compared to 22% who reported that none of their friends breastfed ($p=0.000$).

As confirmed by other investigators, the association between early weaning and smoking is strong and consistent in the literature (Ford *et al.*, 1995; Hamlyn *et al.*, 2002). According to Italian research, Giovannini *et al.*, (2004) identified maternal smoking as an independent predictor of early weaning ($p < 0.05$). While early weaning was significantly associated with mothers who smoked during pregnancy ($p=0.000$) in the present study, after adjustment in the socio-demographic model (see **Table 7.16**) this relationship did not persist ($p=0.692$).

Mothers' employment status

Although 38% of mothers returned to work during the first 6-months, these results suggest that return to work, either part-time or full-time did not influence early weaning ($p=0.605$) (see **Table 7.5**). Comparable with findings from the UK (Earland *et al.*, 1997), there was, however, a non-significant trend in the univariate analysis towards early weaning among mothers who returned to work ≤ 18-weeks, with 67% of these mothers dominating the early weaning group ($p=0.067$). Furthermore, all of the mothers who returned to work (38%) also reported that their infants attended a crèche facility (38%), thus were cared for outside the home. It could be deduced that there was increased pressure among the mothers who returned to work ≤ 18-weeks to have their infants weaned onto solids. Although the number of mothers who reported returning to work by 6-months in this study was low (n = 152), a larger sample size may have detected a significant difference between return to work ≤ 18-weeks and early weaning. Since the completion of this study in 2006 however, and following the Irish Budget in 2007, maternity leave for mothers in Ireland increased from 22 weeks to 26 weeks. Under this current and up-dated maternity leave duration, which became active from March 1st 2007, mothers now have the option to take a further 16 weeks unpaid leave from work, in addition to the statutory paid maternity leave of 26 weeks. Thus, such a recent shift towards longer maternity leave duration may delay the initiation of weaning among some working mothers.

Infant characteristics

Several investigators in the area of paediatric research have confirmed gender as an important predictor of early weaning with a greater propensity towards earlier weaning of males than females (Forsyth *et al.*, 1993; Ford *et al.*, 1995). However this association was not observed in our findings as similar proportions of males were weaned early (53%) as females (47%) ($p=0.630$). An earlier examination of the feeding practices of 197 Irish mothers found that multi-parous mothers were more likely to wean < 8-weeks ($p = 0.03$) (Twomey *et al.*, 2000) than primi-parous, however parity was not related to early weaning in the present study ($p=0.146$).

As all infants included in the analysis were term (gestational age ≥ 37 weeks) and healthy, it is unsurprising that gestational age was not associated with early weaning ($p=0.718$). However, it is relevant that a greater proportion of infants who were born small for gestational age ($p=0.017$) and ≤ 2.99kg ($p = 0.01$) were more likely to be weaned earlier than infants born large for gestational age and born > 4kg, although this relationship did not persist after adjustment for maternal age, education, parity, smoking status and the gestational age of the infants' at birth. In keeping with this pattern, infants born ≤ 2.99kg were significantly more likely to have been offered unsuitable snack foods ($p=0.02$) and to have mothers who added inappropriate condiments to their weaning foods (*p=0.030*). Since gestational size at birth and birth weight are inter-related (see **Section 7.3.2**), it would be expected that similar relationships would be observed. A number of investigators have demonstrated that infant body size is a significant predictor of the timing of weaning (Savage *et al.,* 1998; Wilson *et al.,* 1998). For instance, Forsyth *et al.,* (1993) reported that a birth weight ≥ 4kg was a predictor of weaning < 12-weeks. Fewtrell *et al.,* (2003) observed that infants who were small for gestational age at birth, whether formula or breast fed, were significantly less likely than infants born appropriate for gestational age at birth to have received solids by 12-weeks. Conversely, however, in a sample of 105 African-American infants, Boyington & Johnson (2004) found that more infants perceived by their mothers as small, were introduced to solids significantly earlier, compared to infants perceived as average *(p=0.03)*. It could be suggested that in an effort to increase the infant's weight at a faster rate, mothers with infants born small for gestational age or birth weight ≤ 2.99kg introduced solids at an earlier stage in the present study. It is also noteworthy that no significant difference was found (*p=0.501*) between infant size for gestational age at birth and mothers who reported *'infant hunger'* as a reason for initiating weaning, thus mothers' of infants who were small for gestational age at birth were not more likely to have introduced solids owing to infant hunger (see **Table 7.13b**). These results may indicate that early introduction to solids among small for gestational age infants was culturally, rather than biologically driven, with mothers perceiving these infants to need more food. Moreover, parental eagerness to visually observe their infants gain weight may be affirmative to their roles as carers and nurturers.

The findings of this study also suggest a general non-significant 'trend' towards early weaning among infants who gained most weight from birth to 6-weeks and from birth to 6-months. Although the 6-week and 6-month anthropometric measurements were available for some of the sample (234 and 97 infants respectively), the negative correlation between weight gain from birth to 6-weeks and from birth to 6-months suggests that the infants who gained most weight during these periods were possibly weaned earlier than those who grew at a slower weight velocity. Interestingly, rapid weight gain to the age 6-weeks was highlighted as an independent predictor of early weaning by Wright *et al.,* (2004). The investigators reported that rapid weight gain may have resulted in a higher feeding drive among these infants, which mothers interpreted as a need for solids. Moreover, an earlier study found that an infant's energy intake appears to reflect infant demands (Stuff & Nichols, 1989).

Another report found that absolute size attained at 6-weeks of age is more influential than the growth trajectory of the infant prior to this point (Fewtrell *et al.,* 2003) which suggests that the heavier weight infants were weaned earlier, rather than earlier weaning being associated with rapid weight gain. Overall, the evidence is inconclusive as to whether weaning is biologically driven or whether social factors are more important. Moreover, the longer term effects of early weaning on later weight status have been conflicting with some studies indicating that the age at weaning bears no association with increased risk of becoming overweight at 1 year (Mehta *et al.,* 1998), 18-months (Morgan *et al.,* 2004a) or at age 5 years (Burdette *et al.,* 2006) while others have reported increased body fat and weight at 7 years (Wilson *et al.,* 1998). Early rapid weight gain however has been linked to being overweight at 4-years (OR 1.4, 95% CI 1.3-1.6) (Dennisson *et al.,* 2006), greater general and central adiposity at 5-years (Ong *et al.,* 2000) and increased risk of obesity in childhood and adulthood (Baird *et al.,* 2005). Furthermore, it has been acknowledged that maximal growth rates during infancy should not necessarily be regarded as optimal for long-term health (Reilly & Wells, 2005). Since the present study did not aim to specifically investigate infant growth in relation to infant feeding, the acquisition of complete 6-week and 12-

week anthropometric measurements would have offered more insight into the association between early weaning and absolute weight and weight gain. The degree to which biologically driven reasons including the effect of catch-up growth among infants who were born small for gestational age contributed to early weaning could not be established from this study. A more comprehensive investigation is warranted to explore the relationship between infant birth weight, weight gain during the first 6-months, maternal perceptions of infant size and hunger, in relation to the prevalence of negative weaning practices including early weaning.

Feeding mode and practices

There is little doubt from our results that mothers who breastfed at all during the first 12-weeks (see **Table 7.11**), and in a graded pattern, the longer the breastfeeding duration post partum, the less likely mothers were to wean early (*p=0.000*). Significantly, in the multivariate analysis, after adjustment in the socio-demographic model (see **Table 7.16**), formula feeding at 12-weeks was highlighted as an independent predictor of early weaning (*p=0.04*) with these mothers being almost 4 times more likely to have weaned early compared to their breastfeeding counterparts (OR 3.91, CI 1.06 – 14.4). In agreement with these findings, the literature consistently highlights significant and marked differences in weaning practices between breast and formula fed infants (Kwavnick *et al.,* 1999; Hamlyn *et al.,* 2002; Noble & Emmett, 2006), the long-term health implications of which are as yet unknown. Dietz (2001) surmised that differences in weaning practices between formula and breastfed infants may contribute to the higher obesity risk in later life of formula fed infants. Previous research confirmed that not being exclusively breastfed at 4 weeks (Ford *et al.,* 1995) and lack of breastfeeding initiation (Giovannini *et al.,* 2004) were strongly associated with early weaning. A meta analysis of Fewtrell *et al.,* (2003) based on the results of 7 prospective randomised trials, concluded that at 12-weeks post partum, fewer breastfed than formula fed infants were receiving solids (38% and 71%, respectively) and that formula fed infants received solids 2 weeks earlier than their breastfed counterparts. Moreover, in the landmark longitudinal Euro Growth study (Freeman *et al.*, 2000), breastfeeding duration was significantly ($p<0.001$) correlated with the age of introduction to solids ($r = 0.41$). It has been suggested that mothers who breastfeed compared to formula feed, may be more aware of the possible problems of early weaning (Wilkinson & Davies, 1978).

It is particularly relevant from the present study that the mothers who weaned early, also performed several other sub-optimal weaning practices. For instance, these mothers were significantly more likely to have inappropriately provided a casein-based formula feed to their infants at 6-weeks (60%) ($p=0.000$), were more likely to add unsuitable condiments such as gravy and salt to the weaning foods (60%) ($p=0.000$) and to offer unsuitable snack foods such as biscuits and chocolate (32%) ($p=0.000$) to their infants. Moreover, the strength of the association between mothers who weaned early and those who added solid foods to infant feeds was significant in the univariate analysis ($p=0.002$) as well as in the final psychosocial model (see **Table 7.17**), after adjustment for confounding variables ($p=0.022$). The fact that mothers who weaned early were also significantly more likely to conduct other negative weaning practices highlights a need to further understand the reasons underpinning the occurrence of such practices. It may be suggested that these infants, on whom multiple sub-optimal weaning practices were being conducted, are at a greater health disadvantage both in the short and long term compared to infants who did not experience such practices.

Ante natal feeding intention

Few studies have examined mothers' ante natal weaning beliefs, knowledge or attitudes in relation to weaning practices post partum. Unexpectedly, our results reveal that mothers' ante natal expectation as to when they anticipated the initiation of weaning post partum was the strongest independent predictor of early weaning, even after adjustment for socio-economic confounding (*p=0.000*). In contrast, qualitative research from the USA revealed that only 6% of mothers (n = 65) had formed any plans as regards weaning, including the timing of weaning, either ante natally, or soon after the birth (Heinig *et al.*, 2006). Regardless of maternal age, education level, smoking status or parity, the ante natal belief of the weaning time post partum remained the most influential factor in predicting early weaning with mothers (see **Table 7.16**) whom ante natally expected to wean ≤ 12 week being over 7 times more likely (OR 7.33, CI 3.17 – 16.75, *p=0.000*) to wean early than those who reported > 17-weeks. This study was not designed to investigate mothers' level of weaning or general infant feeding knowledge, thus this knowledge was not assessed either ante or post natally. However, it could be argued that mothers ante natal expectation or belief as to when they would initiate weaning post partum was related to their weaning knowledge during the third trimester of pregnancy. Such findings provide public health promotion campaigns a valuable opportunity to correct mothers' feeding misperceptions during the ante natal period and accurately inform mothers, and their mothers, of best practices. Moreover, Kwavnick *et al.*, (1999) observed that improving a person's knowledge may be more worthwhile than attempting to modify socio-demographic risk factors. Although the acquisition of professional weaning information did not appear to influence weaning time in this study (*p=0.119*), the fact that 41% of mothers in the total sample reported that they did not receive weaning advice warrants further attention.

Ante natal class attendance

As outlined in **section 5.1.1**, information on weaning infants onto solids is incorporated into the Coombe Women's Hospital ante natal class programme. Maternal (*p=0.000*) and paternal attendance (*p=0.000*) at ante natal classes both in the hospital and in their local community, at the time of recruitment, was indicated as a significant influence on the timing of weaning in the univariate analysis, however, the number of ante natal classes attended did not appear as a determinant (*p=0.641*). Moreover, ante natal classes were reported as a significant ante natal infant feeding information source by mothers who weaned late (26%) compared to those who weaned early (14%) *(p=0.031).* As data on ante natal attendance was collected only during the ante natal period, (see **Section 7.3.3**), a separate analysis was undertaken among the mothers who were > 30 weeks gestational age (n = 334), a period beyond which mothers were likely to have commenced the ante natal classes. This analysis also highlighted a significantly lower level of attendance at the ante natal classes among the mothers (65%) (*p=0.001*) and partners (79%) (*p=0.003*) in the early, compared to the late weaning group. It may be suggested that mothers who attended ante natal classes had a greater advantage in that they received more infant feeding information, which is a component of the classes delivered in the hospital where the study was carried out, and thus were better informed ante natally of best feeding practices. Furthermore, those who attended the ante natal classes, which are optional and available to all mothers and partners, may have been better educated, more likely to comply with favourable health behaviours and hence have been more motivated to adopt feeding recommendations. These findings may also suggest that mothers who do not attend the ante natal classes are at greater risk of inappropriate feeding practices post partum and are hence the group that the public health system may most need to target in ante and post natal educational intervention programmes. Encouraging all mothers and ‘their mothers’, to attend ante natal classes, and in particular promoting an ante natal refresher class for multi-parous mothers may prove beneficial in up-dating and improving feeding practices. Above all, our results indicate that the ante natal period represents an opportune time, when exposure to infant feeding information appears to be most critical to the modification of feeding practices post partum.

Sources of weaning information: To whom are mothers listening?

It is well documented that socio-demographic influences play a huge role in explaining the prevalence of early weaning (White *et al.,* 1992; Foster *et al.,* 1997); however, the importance of a mother's social group and network in affecting her infant feeding beliefs and practices can never be underestimated (Alder *et al.,* 2004). Psychosocial influences have been suggested to be major determinants of weaning practices (Anderson *et al.,* 2001), thus, a number of possibilities must be considered when discussing their influence on early weaning.

In agreement with previous studies, (Kannan *et al.,* 1999; Carruth & Skinner, 2001), a particularly relevant finding in this research was the significant influence of the maternal grandmother on mothers' infant feeding practices. The majority of mothers in the early weaning group were more likely to report the maternal grandmother as a source of infant feeding information ante natally (64%), during the first 6-weeks post partum (56%) and from 6-weeks until 6-months (59%) (p = *0.000*). Of further significance, results from the final adjusted socio-demographic model reveal that mothers who weaned early were over twice as likely (OR 2.26, CI 1.21 – 4.25) to have reported the maternal grandmother as a principal source of weaning information (p = *0.011*). This particularly worrying finding in the present study suggests that the maternal grandmother negatively impacts on the prevalence of optimal infant feeding practices by the potential provision of inaccurate and out-dated advice to their daughters. Similar observations were made by Alder *et al.,* (2004), who reported that the opinions of the maternal grandmother and friends were significant in influencing the timing of weaning. A further examination of the principal sources of weaning information among mothers (see **Table 7.10**) indicates 'family and friends' as a principal source of weaning information in the early weaning group (42%) compared to only 17% of mothers who reported health professionals as an information source. In contrast with research from the USA, Crocetti *et al.*, (2004) discovered that a large proportion of mothers depended upon the local health care nurse as their principal source of weaning information (74%), followed by weaning literature (68%) and family members (58%).

The fact that the influence of family and friends, and in particular, the maternal grandmother, was found to have a negative influence on recommended weaning practices in the present study, suggests that despite the provision of information and advice from health professionals, mothers continue to comply with familial advice. This finding coincides with previous Irish research (Fennessy, 1999) and data from Baughcum *et al.*, (1998) who reported that mothers in the USA acknowledged that they ignored advice from health care providers, and relied instead on their own mother's advice. It is unlikely that the maternal grandmother would intentionally misadvise mothers, however, compliance with traditional feeding practices that have been inter-generationally 'handed-down' may be more influential on mothers' practices than the professional advice received. This suggestion is substantiated by Daly *et al.*, (1998) who attributed the high prevalence of inappropriate practices to the incorrect guidance by older family members. Moreover, the latter report found that the infant feeding advice offered by the maternal grandmother was frequently flawed and inaccurate, however, was readily adopted and had the advantage of being readily available to mothers. Mothers have been shown to rely heavily on the infant feeding advice from relatives and friends (Horodynski *et al.*, 2007), be influenced into the earlier introduction of solids by familial pressures (Harris, 1988) and maybe more influenced by their social network than the advice provided by health professionals (Matthews *et al.*, 1998). The dominant role of the maternal grandmother may be due to the mother's dependence upon the grandmother (Bentley *et al.*, 1999) or perhaps the daily social presence of family and friends has more effect on maternal decision making than remote professional presence

(Matthews *et al.*, 1998). It has also been suggested that advice from family and friends corresponds with mothers' own inclinations and needs, and directly addresses difficulties that professional advice does not consider (McIntosh, 1986).

More mothers who weaned early (7%) than late (3%) reported that '*maternal instinct and common sense*' was their guiding source on weaning practices. In addition, significantly fewer mothers in the early, compared to the late weaning group reported weaning books as a source of weaning information from 6-weeks until 6-months (*p=0.000*). Similarly, an examination of the reasons for early introduction to solids carried out by Wright *et al.*, (2004) showed that agreement with the statement *'a book or leaflet suggested I should initiate weaning'* was associated with later weaning. More importantly, despite that fact that 52% of mothers in the early weaning group reported to have received professional weaning advice in the present study, no mother in the early weaning group reported '*adherence to infant feeding recommendations*' as a reason for introducing solids, in comparison to 20% of mothers in the later weaning group (see **Table 7.14**). It could thus be suggested that mothers who wean early are more likely to comply with non-evidence based information, and more likely to adopt practical weaning practices that have been anecdotally recommended by family and friends, despite the fact that these practices are unfavourable and may have deleterious consequences for infants.

It is unsurprising that the PHN as a source of weaning information exerted a positive influence on appropriate weaning practices among mothers, with these mothers being 70% less likely to have weaned earlier (OR 0.3, CI 0.135 – 0.682) in the final socio-demographic model (*p=0.004*). Although 48% of mothers in the early weaning group reported that they did not receive professional advice on weaning during the first 6-months, results strongly suggest the influential role of the PHN in promoting favourable weaning practices among mothers who had contact with the PHN. These findings also call into question the most effective time post partum for the provision of professional and formal weaning advice to mothers in Dublin. Owing to the fact that weaning advice is generally initiated at the 12-week developmental check up with the PHN (see **Appendix XII**), it is thus unlikely that professional information on weaning would have been imparted to mothers during the first 12-weeks post partum. Since the present study did not collect information on the timing of the initial provision of professional weaning information to mothers, it is difficult to speculate whether the weaning information was received in advance of initiating weaning, which if provided earlier, may have delayed the weaning process. The acquisition of professional weaning information at 12-weeks post partum or beyond however, was evidently too late for the 23% of mothers who had already weaned their infants onto solids. The fact that mothers who weaned early were significantly more likely to carry out other sub-optimal weaning practices as described in **Table 7.12** alerts us to the possibility that an overall deficiency in weaning information may exist among these mothers. However, the fact that no mother in the early weaning group reported *'adherence to infant feeding recommendations'* as a reason for introducing solids, despite the fact that 52% of these mothers received professional weaning advice and all of these mothers were registered with a PHN post partum, may indicate a lack of adherence to formal weaning information among the mothers who weaned early. Previous research suggests that mothers who are aware of feeding recommendations are still likely to wean prematurely, based upon influences from their social network (Anderson *et al.,* 2001; Crocetti *et al.,* 2004) or owing to lack of confidence in the professional advice provided (Sarwar, 2002). It has also been reported that mothers are reluctant to ask health care professionals for assistance when faced with feeding difficulties and rely on relatives and even strangers in public for infant feeding guidance (Heinig *et al.,* 2006).

Our data thus suggest that parental familial beliefs and inter-generational practices may over-ride the influence of infant feeding recommendations, as well as the professional advice imparted to mothers. Moreover, mothers may be ignorant of, or less troubled by the health concerns and risks that early weaning may impart to their infants such as eczema or iron deficiency anaemia. It has been postulated that parents are not witnessing the predicted harmful effects of early feeding with solids and may perceive the practice to be beneficial to their infant (Forsyth *et al.*, 1993). It appears that the public health challenge is to creatively persuade mothers of the benefits of delaying weaning until 4 months as well as to relay the risks associated with early weaning, as a means to help motivate mothers to adopt these recommendations. Recent findings from the USA support this suggestion (Horodynski *et al.,* 2007), reporting that potential threats to the infant's health may be stronger motivators for mothers, than messages that point to the health benefits for delaying weaning until 4-6 months. An incorporation of more user-friendly scientific explanations underpinning infant feeding guidelines both in the public health literature and PHN advice relating to their infant's long and short term health, may encourage mothers to re-think their feeding practices.

Attitudinal and psychosocial influences

It is suggested that if parents are to be encouraged to delay the introduction of solids until 4 months, it is crucial to assess and document their reasons for introducing solids earlier. The generally categorized reasons (see **Table 7.14**) as to why mothers introduced solids highlight that 'baby-led reasons' were reported most commonly by mothers in both the early (58%) and late weaning groups (47%). Mothers' response to the hunger-related behavioural actions of the infant such as '*the infant was waking up overnight'*, '*the infant was starving all the time'*, '*downing the bottles*' or the response to hunger-related physical actions such as the infant '*was chewing his/her fist'*, '*grabbing food'* or '*salivating when watching the parents eat'* appeared to be important motivation cues and driving factors for mothers to initiate weaning. Mothers who felt that the infant was *'hungry'* or perceived the infant to be *'starving'* (67%) were significantly more likely to wean early (*p=0.000*), than mothers in the late weaning group (44%). Moreover, this association remained in the final 'attitudinal and psychosocial model' (see **Table 7.17**) (OR 3.31, CI 1.77-6.19). These results are in agreement with those of Wright *et al.*, (2004) who reported that the statement '*I started solids because seemed hungry'* was associated with early weaning. Physical characteristics indicating 'readiness' and perceived hunger of the infant have been demonstrated as key influences on the introduction of solids. Comparable with our findings, earlier work by Harris (1988) in a sample of 40 mothers in Birmingham found that solids were introduced in response to an observed change in infant behaviour in 75% of cases, such as increased feeding frequency or the return of waking overnight, signs which suggest a higher feeding drive among these infants and increased nutritional requirements.

Results also highlight that mothers who weaned early may be more likely to misperceive the effects of certain feeding practices on infant behaviour. In particular, mothers who perceived the infant to be a *'big baby'* in the present study and so perceived the infant to require more food, were over 6 times more likely initiate weaning (OR 6.04, CI 1.67 – 21.8) (*p=0.006*). It has been postulated that parents may wean early owing to the perception that this feeding skill is a sign of maturity, along with the desire to see their infants gain weight rapidly (AAP, 1980). Convincing data suggest that mothers' central reasons for introducing solids prematurely are related to their perception that the infant is hungry and dissatisfied with formula or breast milk alone (Fewtrell *et al.*, 1993; Savage *et al.*, 1998). Moreover, it is also established that infants experience growth spurts between the first one to two weeks post birth, six weeks and again at twelve weeks, the latter which has been described as the 'three-month fussy period' (La Leche League, 2004) as a result of increased appetite. It has been suggested that infant hunger during the first 12-weeks post partum however, is best managed by an increased breast or formula feeding frequency, rather than introducing solid food (La Leche League, 2004). Other investigators have demonstrated that mothers continue to prematurely introduce solids based on infant behavioural changes associated with hunger, rather than complying with external advice (Alder *et al.,* 2004; Crocetti *et al.,* 2004; Wright *et al.,* 2004).

Of relevance, our results indicate that there was a greater propensity towards early weaning among infants who were small for gestational age at birth and born ≤ 2.99kg; however, mothers who reported that they perceived the infants to be '*big babies'* were more likely to wean early ($p=0.006$). These findings are contraindicatory, as it would be expected that infants who were large, rather than small for gestational age would be weaned earlier owing to a larger size and increased nutritional requirements. It would thus make sense if their mothers initiated weaning owing to their infants being 'bigger babies' that required more feeding. In addition, no significant associations were found between mothers who reported *'infant hunger'* as a reason for initiating weaning and the infants size for gestational age at birth ($p=0.501$), thus infants who were small at birth were not more likely to have been reported as 'hungrier infants'. Together, these findings may suggest a potential misperception among these mothers of infant size in relation to physiological need. Qualitative results by Heinig *et al.*, (2006) highlighted that an infant who is 'full and satisfied' and perhaps even fat, is perceived by mothers as being healthy and happy. Moreover, Anderson *et al.*, (2001) suggested that there may have been a general parental eagerness to observe this stage of development, or a parental will to want their infants to grow at a faster rate.

The fact that mothers who perceived that the provision of solid foods to infants would '*promote sleep*' and '*help the infant to settle*' were almost 5 times more likely to initiate weaning ($p=0.000$) is substantiated in the literature (Clark & Beal, 1981; Alder *et al.,* 2004; Heinig *et al.,* 2006). It is perceived that infants who are weaned onto solids sleep through the night and this may be an incentive to commence weaning earlier than recommended, however, Sears (1999) pointed out that infants are not designed to sleep through the night. Moreover, daytime breastfeeding frequency has been shown to decrease at 6-months among mothers who weaned < 6-months ($p<0.05$) compared to those who wean ≥ 6-months, however, no differences were found in the night time breastfeeding frequency between these groups (Heinig *et al.,* 1993a). Baughcum *et al.,* (1998) suggested that parents who wean early may not accurately perceive hunger cues in their infants and that a pattern could subsequently develop in which the parents use feeding to shape non-eating behaviour, which may in turn increase the risk for childhood and even adult obesity. Despite the fact some mothers perceive the introduction of solids to promote sleep, it has been shown that infants weaned onto solids < 6-months compared to ≥ 6-months had virtually identical sleeping times (729 minutes per day versus 728 minutes per day, respectively) (Heinig *et al.,* 1993a). Fomon *et al.,* (1979), in an earlier review of infant feeding, did not accept that long periods between feeds would be advantageous to the infant. It has also been suggested that the use of food to 'comfort' a baby rather than to relieve hunger illustrates one of the non-nutritional uses of food, which are used as parental coping strategies (Anderson *et al.,* 2001).

Characteristics of mothers who conduct negative weaning practices

Following a univariate analysis of mothers who offered inappropriate snacks to their infants and those who added unsuitable condiments to the weaning foods, a significant socio-economic gradient was observed. The fact that almost half of the mothers (46%) who offered unsuitable snacks to their infants were aged ≤ 24 years and smoked (54%), the majority of whom had public health insurance during pregnancy (81%) and who had an educational attainment level to primary/secondary school level (75%) (*p=0.000*) clearly indicates a higher preponderance of inappropriate weaning practices among lower socio-economic groups in our society. These findings also highlight that maternal negative health behaviours are related to negative weaning practices.

Similar to the determinants of early weaning, a greater proportion of mothers who were students or unemployed ('unknown category') and those who were stay-at-home mothers were significantly more likely to add unsuitable condiments to the infant weaning foods (21% and 21% of mothers, respectively) and offer inappropriate snacks to their infants (33% and 24% of mothers, respectively) than mothers in Social Class 1 or 2 (see **Table 7.18**). Of further relevance, mothers who offered inappropriate snacks to their infants were more likely not to have been in employment at 6-months (75% of mothers) and less likely to have been full-time working mothers (8%). These findings re-enforce the suggestion that non-working mothers in this study were at greater risk of carrying out sub-optimal feeding practices. Although time constraints and increased work-life balance pressures may have been issues for working mothers, and thus potential barriers to feeding their infants in compliance with recommendations, these mothers were still less likely to conduct negative weaning practices. Moreover, mothers who complied with feeding recommendations including better educated, older mothers, were significantly more likely to source their weaning information from evidenced-based infant feeding books and general literature (*p=0.000*), rather than comply with information from the maternal grandmother (*p=0.000*) or follow their own '*common sense'* as a guide to feeding their infants.

Similar to the determinants of early weaning, the acquisition of formal weaning advice from a health professional did not appear to influence mothers who added unsuitable condiments to the weaning foods (*p=0.198*) nor those who provided inappropriate snacks to their infants (*p=0.817*). The fact that mothers' satisfaction with the advice they received from a health professional was not significantly associated with the prevalence of negative practices (see **Table 7.22**) indicates that non-compliance with feeding recommendations was unrelated to mothers' perceptions that the professional advice was incomplete, sub-optimal or inadequate. Another important finding is the observation that no significant association was found between mothers who reported the PHN as a source of weaning information and those who added unsuitable condiments to the weaning foods (*p=1.000*) or those who provided snack foods to their infants (*p=0.192*). Conversely, weaning advice from the PHN was highlighted as an independent 'positive' predictor of adherence to the recommended timing of weaning in the final socio-demographic model (*p=0.004*). These results suggest that the PHN may have deterred many mothers from weaning early, emphasising the timing of weaning as an important facet in the weaning advice, however, may not have incorporated advice on poor snacking practices or the inappropriateness of adding gravy and such condiments to the infant foods during the first 6-months. Our results thus highlight that the weaning advice should not only be imparted to mothers during the ante natal period and the early weeks post partum, but should also incorporate the disapproval of sub-optimal weaning practices such as premature weaning and inappropriate snacking, as well as deleterious long term effects associated with such practices.

Strengths and limitations of the study

The validity of the data was maximized by using the same trained paediatric research dietitian and instruments for data collection including three standardised questionnaires, in addition to the recruitment and follow-up of an adequate number of national mothers which enabled multivariate analysis. However several limitations of the work must be mentioned. Firstly, the fact that mothers were recruited and lived within a similar geographical area may limit the generalizability of the data to the rest of Ireland. A multi-sited study or a comparative study examining feeding practices in a rural area in Ireland may have resulted in a different demographic profile of mothers and hence potentially different results.

Importantly, maternal recall bias needs to be considered when interpreting the data. As the infant feeding information and timing of first introduction to solids was collected retrospectively notably at the 6-month time point, it is possible that some mothers may have incorrectly estimated the actual time when they initiated weaning. The provision of a weaning logbook during the first 6-weeks to mothers (Howie *et al.,* 1990) may have decreased any memory bias, however owing to practicality and a high sample size, this task would not have been possible for one investigator.

The fact that specific information was not collected on mothers' knowledge of the weaning guidelines, including the recommended weaning time, must also be mentioned. An assessment of mothers' weaning knowledge ante or post natally may have influenced her actual feeding practice post partum, thus the final results would not have been representative of the habitual weaning practices of a convenience sample of mothers in Dublin. Although it could be suggested that a mother's ante natal expectation as to when she thought she would introduce solids post partum was related to her weaning knowledge, this question did not specifically assess mothers' knowledge of the 'weaning recommendations', which may have elicited a different response to their own personal ante natal opinions of weaning time post partum. For the purpose of comparison with this study, future infant feeding research should include an assessment of mothers' weaning knowledge in relation to actual feeding practices.

In addition, information on ante natal class attendance was elicited at the time of the first recruitment contact with mothers (35.18 weeks ± SD 4.26 weeks: min-max 24-42 weeks). Although class attendance was not highlighted as a significant infant feeding source of information during the first 6-weeks, or between 6-weeks and 6-months, it would have been more useful and effective to data interpretation to have collected information on attendance at the ante natal classes in the post natal 6-week questionnaire.

Finally, there are many different approaches to constructing multi-variate models (Pallant, 2007b), a process which can be subjective. Following an initial comprehensive exploration of the relationship between key socio-demographic factors and early weaning, only the significant variables in the univariate analysis were included in the final models.

7.6 Conclusions

Overall, this study contributes towards our current knowledge base in providing a better understanding of the factors associated with early weaning and other unfavourable weaning practices. The reasons underpinning the timing of introduction to solids are multi-faceted and may be interrelated. Conflicting reports in the literature make it difficult to arrive at an authoritative conclusion as to whether early weaning is biologically driven or whether social factors and mothers' perceptions of the baby's needs are more important. Our study, however, demonstrates that mothers' beliefs, perceptions and familial influences were as important in determining early weaning as socio-economic markers. It could be argued that mothers from lower socio-economic classes share similar perceptions and beliefs, which are further re-enforced by their social network, and are less likely to comply with formal infant feeding information in favour of practical advice imparted by the maternal grandmother. Nonetheless, knowledge of these at-risk mothers, together with a comprehensive understanding of their reasons for early weaning allow us to better target these groups and more efficiently address the deficiencies in our public health system.

An important observation from this study is that mothers who fail to comply with feeding recommendations are a 'collective group' of mothers. It is significant from a public health perspective that mothers who wean their infants prematurely, are also more likely to carry out other sub-optimal practices. Of concern, these infants may be at greater risk of later overweight (Wilson *et al.,* 1998), Type I Diabetes Mellitis (Ziegler *et al.,* 2003) and eczema (Fergussen *et al.,* 1990; Zeiger, 2003). There is evidence to support the possibility of the early diet in 'priming' infants and children for unfavourable health outcomes in later life including high blood pressure (Zinner *et al.,* 2002) and the development of unhealthful food preferences (Skinner *et al.,* 2002a). However such risks are preventable. The possibility that these infants, on whom multiple negative weaning practices are being carried out, are at greater health disadvantage from the first year of life is further widening the health inequalities in our society. Moreover, Stettler *et al.,* (2003) affirmed that evidence-based prevention is a public health priority and should target well-defined risk factors and critical periods.

This study also demonstrates that over-riding the familial influence, in particular that of the maternal grandmother, presents a major public health challenge. Our results strongly suggest that education on infant feeding requires a family, and extended family-centred and social-network approach. Although some vulnerable mothers are arbitrarily assigned to a 'community care mothers scheme' in Ireland for support in feeding and the general care of their infants (see **Appendix XII**), the possibility of initiating a mother-to-mother community care support paradigm as a means of follow-up support for all younger and less educated mothers during the first year post partum, should be considered. It is likely that mothers from lower socio-economic groups may bond with mothers of similar backgrounds, and thus may be more likely to adhere to their advice and increase the receptivity of important nutritional messages. In turn, mothers from lower socio-economic groups may positively influence other such mothers, and may advise their own daughters of better weaning practices, thus improving the quality of infant diets. In order to break the inter-generational influence on negative weaning practices, intensive education, support and increased resources should be apportioned to younger mothers from lower socio-economic backgrounds. Crucially, however, research is needed to investigate the optimal and most effective way to increase the impact of the health professional in the community on mothers' feeding decisions, and hence over-ride the influence of non-evidence based information from family and friends. Interventions that inform and influence the mother's extended family, especially the maternal grandmother, may prove valuable in modifying and up-dating traditional practices.

Chapter 8 General Discussion and Conclusions

The relationship between early infant nutrition, health outcomes and disease risk in later life is recognized globally (WHO/UNICEF, 2003c). Historically, infant nutrition has focussed on the prevention of malnutrition and nutrient deficiency states, however, the emphasis is now towards achieving a balanced protein and energy intake and preventing the risk of long-term disease (ESPGHAN, 2008). A growing body of evidence indicates that poor compliance with infant feeding recommendations may have short and long-term deleterious health effects on infant growth and development (Lozoff *et al.,* 1991; Wilson *et al.,* 1998; Dietz, 2001), highlighting the importance of ensuring optimal nutrition during early life.

The present study was undertaken to investigate the diets of infants born in Ireland during the first 6-months of life and to subsequently assess compliance with infant feeding recommendations.

Results from our study highlight an extremely low level of compliance with the WHO (2001) recommendation, with only one national mother exclusively breastfeeding at 6-months. National mothers are still reluctant to initiate breastfeeding with particularly high discontinuation rates observed among this population during the first 4-weeks post partum. Based on the present study, it appears that breastfeeding rates in

Ireland remain strikingly low in comparison with our European counterparts. Although breastfeeding rates were significantly higher among the non-national mothers, our results indicate that the exclusive breastfeeding rates remain low in both populations. A national monitoring system as recommended by Cattaneo *et al.*, (2005), that aims to collect well-defined breastfeeding data at standardised timepoints during the infant's first year needs to be considered at a population level, and would enable the observation of early feeding trends over time. Given the predominant formula-feeding culture in Ireland, an examination of the impact of immigration on the breastfeeding practices of non-national mothers in future research is worthy of investigation.

Undoubtedly, the cultural attitude towards breastfeeding initiation and duration would appear to be the single and most crucial determinant of breastfeeding intention, initiation and success among mothers here in Ireland. The maternal perception that breastfeeding is an embarrassing method of infant feeding strongly prevails in our society. Addressing this cultural barrier in the wider community appears central to improving rates and would merit more in-depth discussion among public health policy makers. The successful national implementation of the smoking ban in the workplace in 2004 highlighted the possibility that public health policy can positively affect a cultural change in Irish society, for the betterment of the health of the nation. If our breastfeeding rates are to ever improve, more aggressive and creative breastfeeding campaigns that relate directly towards addressing the negative cultural perception of the practice need to be considered.

Significantly, findings indicate that the ante natal period should be targeted as being the most effective time in which to influence and affect mothers' attitudes and beliefs pertaining to breastfeeding and weaning practices post partum. The inclusion of the partner and the maternal grandmother in educational strategies appears pertinent to improving breastfeeding and weaning practices across all socio-demographic groups.

Based on our data, the development and provision of specific and dedicated literature directly relating to the unique role of the partner and maternal grandmother in influencing the feeding decisions during the ante and post natal period should be considered. As the PHN was identified as a key positive professional influence on both breastfeeding and weaning practices, our results call for greater facilitation of PHNs with dedicated time to support mothers in the community.

In specifically addressing the issues arising from the present study, our findings strongly suggest the need for the implementation of hospital and community-based breastfeeding interventions. Future research could assess the influence of ante natal midwife-led breastfeeding motivation clinics for prospective parents on initiation and duration rates post partum. Well-designed interventions incorporating the strong presence and influence of the partner would prove invaluable to the formation of future national promotional campaigns. The effectiveness of a 24-hour midwife-led national breastfeeding hotline could also be investigated. In addition, the unique role of the PHN in affecting positive infant feeding behaviours could be further explored.

According to the present study, a large proportion of mothers failed to comply with the weaning recommendations at 6-months. Of particular public health concern was the finding that 23% of infants were weaned onto solids by 12 weeks post partum calling for urgent attention and more persistent efforts to address this issue. Our findings also suggest the widespread consumption of foods high in refined sugars, saturated and trans-fats among infants at 6-months. Owing to the high frequency of consumption of such foods during the weaning period, future nutrient analyses of infant diets would prove valuable in quantitatively determining their nutritional intake. Furthermore, greater specificity is required in the weaning advice and literature provided to parents pertaining to appropriate volumes of sugar-containing fluids, the home-preparation of infant foods and healthier snack options.

Public health efforts to improve the weaning diet could consider the implementation of a national weaning protocol that would ensure the provision of accurate, consistent and practical weaning information to all parents. However, such information may need to be imparted as early as the 6-week check-up with the GP or the paediatrician, as appropriate. Above all, the consideration of a well-designed infant feeding reference pack to all mothers during the ante natal period, encompassing breastfeeding and weaning advice, may prove the single most effective measure to improving the early diet. The compilation of an updated national infant feeding policy incorporating the data provided by the present study may be crucial to directing public health strategies and future infant feeding research, as well as highlighting current paediatric-related issues of concern among both clinical and community-based health professionals.

Finally, our results define the many challenges facing our health system and have identified several infant feeding practices of concern that call for implementation of high-priority action. For infants born in Ireland, a country with the highest birth rate in Europe (Eurostat, 2007) and one with rapidly increasing childhood and adult obesity levels (Southern Area Health Service Executive, 2005), improving and optimizing infant nutrition has never been so important in our society.

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Appendix I

WHO breastfeeding indicators (Global Data Bank on Breastfeeding, 1996)

Household indicators→	**Definition**
Ever breastfed rate	Infants less than 12 months of age who were 'ever' breastfed
Mean duration of breastfeeding	Average duration of breastfeeding in months
Median duration of breastfeeding	Age in months when 50% of children are no longer breastfed
Exclusive breastfeeding rate at 1 month	Infants at 1 month of age who are exclusively breastfed
Exclusive breastfeeding rate at 2 month	Infant at 2 months of age who are exclusively breastfed
Exclusive breastfeeding rate at 3 month	Infants at 3 months of age who are exclusively breastfed
Exclusive breastfeeding rate at 4 month	Infants at 4 months of age who are exclusively breastfed
Exclusive breastfeeding rate at 5 month	Infants at 5 months of age who are exclusively breastfed
Exclusive breastfeeding rate at 6 month	Infants at 6 months of age who are exclusively breastfed
Exclusive breastfeeding rate at ≤ 4 months	Infants less than 4 months of age who were exclusively breasted in the last 24 hours
Predominant breastfeeding rate	Infants less than 4 months of age who were predominantly breastfed in last 24 hours
Timely complementary feeding rate	Infants 6-9 months of age who received complementary foods in addition to breast milk in the last 24 hours
Continued breastfeeding rate (1 year)	Children 12-15 months, who were breastfed in the last 24 hrs
Continued breastfeeding (2 years)	Children 20-23 months, who were breastfed in the last 24 hrs
Bottle-feeding rate	Infants <12 mnths of age, receiving any food/drink from a bottle
Health facility indicators →	
Exclusively breastfed by natural mother rate	% of infants exclusively breastfed by their natural mothers from birth to discharge
Breast-milk substitutes & supplies receipt rate	% of mothers who received breast milk substitutes, infant feeding bottles or teats at any time prior to discharge or during the prenatal visit to the health care facility
Rooming-in rate	% of infants rooming in 24-hours a day beginning within 1 hour of birth, not separated from the mother for more than 1 hour
Breastfed rate	% of infants breastfeeding in 24 hours prior to discharge
Timely first-sucking rate	% of who first suckled within 1 hour of birth
Exclusive breast-milk fed rate	% of infants exclusively breast-milk fed from birth to discharge
Bottle fed rate	% of infants receiving any food or drink from a bottle in the 24 hours prior to discharge
Pacifier use rate	% of infants who received pacifiers at any time prior to hospital discharge

mnths denotes 'months'
hrs denotes 'hours'

Appendix II

Protective bio-factors present in human milk

Factor	**Function**
Secretary immunoglobulin A	Specific antigen-targeted anti-infective activity Anti-bacterial, anti-viral, anti-microbial toxin Major component of local mucosal immunity Protects intestinal epithelium from luminal antigens, and may actively prime the neonate's immune system
Lactoferrin	Immunomodulation, iron chelation, anti-microbial action, anti-adhesive, trophic for intestinal growth. Competes with bacteria for iron, helps to reduce intestinal infection
Lysosyme	Immunomodulation Anti-bacterial enzyme lyses cell walls
Bifidus factor	Stimulates lactic acid bacteria e.g. bifidobacteria in the colon
Macrophages	Engulf bacteria (microbial phagocytosis)
Lymphocytes	Secrete immunoglobulins (B cells) and lymphokines (T cells)
Protease inhibitors	Inhibit digestion of bioactive proteins in milk
Complement	Assists in bacterial lysis
Interferon	Anti-viral agent
Cytokines	Anti-inflammatory, epithelial barrier function
Nucleotides	Enhances the immune response including T-cell maturation and natural killer cell activity. Promotes growth of mucosa
Oligosaccharides	Inhibitors of bacterial adhesion to epithelium
Amino acids: Glutamine	Intestinal cell fuel, promotes the immune response
Enzymes → Glutathione peroxidase Catalase Platelet activating factor: acetylhydrolase	Prevents lipid peroxidation (anti-inflammatory) Anti-inflammatory, degrades hydrogen peroxide Protects against necrotizing enterocolitis
Hormones → Prolactin Cortisol, thyroxine, insulin	Enhances the development of B and T lymphocytes Promote maturation of newborns intestine & development of intestinal host defence mechanism
B_{12} and folate binding proteins	Compete with bacteria for these vitamins
Anti-staphylococcus factor	Lipid with anti-staphylococcus action
Anti-*Giardia* factor	Lipid with anti-*Giardia* action
Vitamins A (β-carotene), E (∝- tocopherol) and C (ascorbic acid)	Anti-oxidants Anti-inflammatory action *via* scavenging of oxygen radicals

Adapted from Hamosh (2001) 'Bioactive factors in human milk'

Appendix III

A summary of the principal recommendations set out in the National Breastfeeding Policy for Ireland Policy (1994)

✓ **Targeting breastfeeding in the maternity hospitals →**

- Promote a rooming-in policy in all maternity hospital and units
- Encourage night feeding to ensure the maintenance of prolactin levels
- Avoid the provision of supplementary feeds unless medically indicated
- Discourage the use of artificial teats and pacifiers
- Ensure that each maternity hospital has a clear written breastfeeding policy & discourage formula feeding literature e.g. free samples and gifts

✓ **Promoting breastfeeding at a community care level →**

- Advise that each health board have a written breastfeeding policy consistent with recommendations
- Promote community ante natal classes
- Ensure the distribution of breastfeeding literature in public health centres
- Set up of weekly 'drop-in' breastfeeding clinics in local health centres

✓ **Focus on training of health professionals →**

- The concept of the '*10 Steps to Successful Breastfeeding'* should be incorporated into a component of nursing and medical undergraduate programmes
- Promote skilled breastfeeding training for all professionals in contact with mothers both ante and post natally
- Include breastfeeding training for general practitioners
- Advise regular in-service training for new staff and up-dated training for existing health professionals both in hospital and in the community

✓ **Promoting breastfeeding within the wider community →**

- Emphasise the role of the media in promoting breastfeeding in a positive perspective
- Recommend the inclusion of basic breastfeeding physiology in social and health education programmes in primary and secondary schools
- Highlight the need for more workplace flexibility for breastfeeding mothers in terms of in-house breastfeeding facilities, lactation breaks and extended optional unpaid leave option for mothers
- Emphasise that there should be no discrimination of breastfeeding mothers in public places

Appendix IV

Ten Steps to Successful Breastfeeding

WHO/UNICEF (1989) Protecting, Promoting and Supporting Breastfeeding: the Special Role of Maternity Services. Geneva, WHO

To promote breastfeeding, every maternity facility should:

Develop a written breastfeeding policy that is routinely communicated to all health care staff

Train all health care staff in the skills necessary to implement the breastfeeding policy

Inform all pregnant women about the benefits and management of breastfeeding

Help mothers initiate breastfeeding within half an hour post birth

Show mothers how to breastfeed and how to maintain lactation even if they need to be separated from their infants

Avoid giving newborn infants food or drink other than breast milk, unless medically indicated

Practice rooming-in, allowing mothers and infants to remain together 24-hours per day

Encourage breastfeeding on demand

Avoid giving artificial nipples or pacifiers to breastfed infants

Foster the establishment of breastfeeding support groups and refer mothers to them at discharge from the facility

Appendix V

Summary of the specific weaning recommendations for healthy infants

	'The initial weaning stages'		*'The second/intermediate weaning stage'*	*'The final weaning stages'*	
Food	**Before 6 months** (17-26 weeks)	**6 months** (26 weeks)	**6-9 months**	**9-12 months**	**12 months**
Skills to learn/develop*	Taking food from a spoon Moving food from the front of the mouth to the back for swallowing Managing thicker purees and mashed food		Moving soft lumps around the mouth Chewing soft lumps Self-feeding using hands & fingers	Chewing minced & chopped food Self-feeding attempts with a spoon	
Feeding frequency	First weaning foods should be offered before milk feeds Begin by offering 1-2 servings per day, gradually increasing the spoon feed amounts 5-6 milk feeds recommended daily ^		2-3 spoon feed occasions per day 3-4 milk feeds recommended daily ^	This stage is marked by a move to 3 meals per day interspersed by snacks and/or drinks 3 milk feeds recommended daily ^	Meals should be centred around the family diet and routine. Encourage a pattern of 3 main meals daily with 2-3 snacks in between. Discourage frequent snacking on fatty, salty or sugary foods. Limit crisps and savoury snacks; offer bread or fruit if the infant is hungry. Allow toddlers to self-regulate their food intake

Food	Before 6 months (17-26 weeks)	6 months (26 weeks)	6-9 months	9-12 months	12-months
Recommended consistency of foods offered	Pureed/thin consistency moving on to smoother/semi-solid consistencies by 6 months e.g. smooth cereals (rice-based, potato or millet) Encourage savoury and bland tastes initially		Minced/mashed foods and soft finger foods Provision of finger foods is important to help develop self-feeding. Start to introduce 'lumpier textures' e.g. toast, rice cakes Encourage savoury foods rather than sweet foods	Normal adult texture e.g. minced & chopped family foods Finger foods remain important	
Suitable first foods	Vegetable or fruit purees, fortified infant cereals, rice-based porridge, cornmeal, sago, millet or tapioca, pureed lentils or beans Dairy products can be offered as a first weaning food e.g. unsweetened fromage frais, custard or plain/natural yoghurt				
Foods that are discouraged during the weaning process	Avoid eggs, fish, shellfish or liver	From 6 months and beyond it is suitable to offer eggs (well cooked until both yolk and white are solid) Soft boiled eggs should be avoided owing to concerns about *salmonella* infection			
	Sugar and salt should not be added to foods or drinks. Foods high in refined sugars should be discouraged including cakes, biscuits, sweets as well as highly salted foods including gravy, processed sauces, tinned/processed soups, cured meats and crisps. Discourage snacking on foods high in salt, fat and sugar Avoid gluten containing foods until 6-months (wheat, rye, barley, oats) Avoid honey owing to the potential contamination with infant *botulism* Chopped and whole nuts may cause choking and should be avoided until age 5 years Pate and soft cheeses (except cottage cheese & cheese spread) should be avoided until 1 year and beyond due to the risk of contamination with *Listeria monocytogens*				

Food	Before 6 months (17-26 weeks)	6 months (26 weeks)	6-9 months	9-12 months	12-months
Supplementary fluids	Cooled boiled water may be offered to infants who are not exclusively breastfed, however prior to 6 months 'infants usually do not need fluids other than milk'	Introduce a cup or beaker Cooled boiled water may be given All drinks other than milk or water should be confined to meal times and should not be given in a feeding bottle or at bedtime	A cup or a beaker cup should be used	A cup or a beaker cup should be used. Ideally the bottle should be discontinued by 12 months Diluted, unsweetened vitamin C containing juice e.g. orange juice can be given with meals, particularly if the infant is not consuming meat	Encourage the use of a cup Do not add sugar to drinks and limit the use of soft drinks e.g. squash and fruit juice
Cow's milk	From 6 months and beyond, cow's milk can be used as a weaning 'mixer' e.g. on cereals, custards and milk puddings. Full fat whole cow's milk can be offered from 1 year as a main milk drink. Lower fat milks should not be offered until 2 years.				
Starchy foods	Smooth cereals e.g. rice-based, mashed potatoes	Smooth cereals e.g. gluten-free, rice-based or mashed potato 1-2 servings per day	Start to introduce more cereals including wholemeal bread, lumpier textures, finger foods e.g. toast and pieces of fruit 2-3 servings per day	Starchy foods of normal adult texture Discourage high fat foods, savoury snacks and pastry 3-4 servings per day	Starchy foods of normal adult texture Discourage high fat foods, savoury snacks and pastry 1 serving with each meal
Fruit & vegetables	Soft cooked vegetables & fruit as a smooth puree	Soft cooked vegetables & fruit as a smooth puree 1-2 servings per day	Raw soft fruit & vegetables as finger foods Cooked fruit & vegetables can be mashed or of a lumpier texture 2 servings per day advised	Lightly cooked or raw foods Chopped finger foods Vitamin C-containing foods e.g. unsweetened orange juice if the diet is meat free 3-4 servings per day advised	Adult texture for fruit & vegetables 5 tastes of per day (fruits & vegetables combined)

Food	**Before 6 months** (17-26 weeks)	**6 months** (26 weeks)	**6-9 months**	**9-12 months**	**12 months**
Meat & meat alternatives (e.g. eggs, fish, pulses)	Use soft cooked meat & pulses as puree Avoid eggs	Encourage iron rich weaning foods, particularly in breast fed infants^ Use soft cooked meat & pulses as a puree At least 1 serving per day Well cooked eggs	Encourage iron rich weaning foods, particularly in breast fed infants^ Soft cooked minced or pureed meat/fish/pulses Well cooked, hard boiled egg can be used as a finger food Limit liver to no more than once per week 1 serving per day	Encourage iron rich weaning foods, particularly in breast fed infants^ Minced/chopped cooked meat/fish/pulses Minimum 1 serving per day from an animal source or 2 from a vegetable source Limit liver to no more than once per week	Encourage iron rich weaning foods, particularly in breast fed infants^ Encourage lean meat & offer oily fish once per week Minimum 1 serving per day from animal source or 2 from vegetable sources Limit liver to no more than once per week

Adapted from ‘Weaning and the Weaning Diet’ Department of Health UK (1994),
* Thomas & Bishop (2007) and the
^ Child Nutrition Panel Weaning Guidelines (2003)

Appendix VI

Summary of weaning recommendations for exclusively and partially breastfed, along with formula fed infant from birth until 12 months

Fluid	**Before 6 months** (17-26 weeks)	**6 months** (26 weeks)	**6-9 months**	**9-12 months**	**12 months**
Exclusively breastfed infants	No solids recommended before 6 months (WHO, 2001; Department of Health UK, 2003; Department of Health and Children, 2003) If mothers choose to introduce solids, 4 months/17-weeks is the minimum age (FSAI, 1999; Department of Health UK, 2003)	Continued breastfeeding (on-demand feeding) Start weaning onto solid foods	500-600mls milk (ideally breast milk, formula milk as the alternative) intake recommended daily Continue to offer solid foods	500-600mls milk (ideally breast milk, formula milk as the alternative) intake recommended daily Continue to offer solid foods ***** Breast feeds will gradually decrease as solid intake increases	***** Breast feeds will gradually decrease as solid intake increases Continue to offer solid foods

Fluid	**Before 6 months** (17-26 weeks)	**6 months** (26 weeks)	**6-9 months**	**9-12 months**	**12 months**
Partially breastfed infants	No solids recommended before 6 months (WHO, 2001; Department of Health UK, 2003; Department of Health and Children, 2006) If mothers choose to introduce solids, 4 months/17-weeks is the minimum age (Department of Health UK, 2003; FSAI, 1999) May need small amounts of additional cooled boiled water (Department of Health UK, 2004)	Continue to partially breastfeed Cooled boiled water may be offered Start weaning onto solid foods	500-600mls of milk offered daily Continue to offer breast and formula milk with solid foods Cooled boiled water is a suitable supplementary fluid	500-600mls of milk offered daily Continue to offer breast and formula milk with solid foods Cooled boiled water is a suitable supplementary fluid	Continue to offer breast and formula milk with solid foods. Breast, formula or full fat pasteurized cow's milk are all suitable milk types Unsweetened fruit juices may be offered with meals, but not advised as a main drink Cooled boiled water is a suitable supplementary fluid
Formula fed infants	No solids recommended before 6 months (WHO, 2001; Department of Health UK, 2003) Irish guidelines advise 4-6 months as appropriate timeframe for weaning formula fed infants (FSAI, 1999) May need small amounts of additional cooled boiled water (Department of Health UK, 2003)	Continue to feed formula milk Start weaning onto solid foods Cooled boiled water may be offered	500-600mls (formula or follow-on formula) milk intake recommended daily Cooled boiled water is a suitable supplementary fluid	500-600mls (formula or follow-on formula) milk intake recommended daily Cooled boiled water is a suitable supplementary fluid	Minimum 350mls milk intake recommended daily. Discourage large volumes of milk; limit to 600mls daily

Adapted from 'Weaning and the Weaning Diet' (Department. of Health UK, 1994); includes the FSAI (1999) infant feeding guidelines and the revised WHO (2001), Department of Health UK (2003) and the Department of Health and Children (2003) guidelines and recommendations.

Appendix VII

Ethical approval for this study was sought and approval granted, subject to signed consent. Copies of the patient information leaflet and the consent form are included.

COOMBE WOMEN'S HOSPITAL

Patient Information and Consent

Title of study:

'An investigation of the diet of the Irish infant from 0-6 months'.

Introduction:

This research project is funded by the Dublin Institute of Technology.

The study aims to recruit approximately 500 pregnant mothers in the last three months of their pregnancy, from the The Coombe Women's Hospital.

The importance of early infant feeding practices and early infant nutrition has been well documented. This study will collect detailed information on how mothers in Ireland feed their infants and what they feed them, from birth to 6 months.

Procedures:

The information regarding infant feeding is collected from three key questionnaires. The first questionnaire is filled-in by the mother in the last three months of her pregnancy in the hospital ante-natal clinic. The second and third questionnaires will be telephone questionnaires where the mother answers the questions upon contact from the researcher of the study. This study is completely 'non-invasive'.

All mothers in the last three months of their pregnancy will be invited to participate in the study from the public, semi-private and private ante natal clinics of the three main Dublin maternity hospitals.

Details about the baby's weight, length and head circumference at 3 weeks, 6 weeks and 6 months will be recorded.

Benefits:

The information collected from your individual participation in this study will benefit subsequent pregnant mothers in Ireland.

The results will be of major importance to the National pool of peri-natal and infant feeding statistics, providing concise, detailed and up-to-date information on infant feeding practices in Ireland.

Risks:

None of note, not applicable to this study.

Exclusion from participation:
Your doctor has told you that you cannot be in this study if any of the following are true:

- The study is subject to healthy, term infants.
- The study will exclude infants who are in-patients in the hospital e.g. in the neo-natal unit, at the time of data collection.
- The study will exclude multiple birth pregnancies e.g. twins.
- Infants requiring a medically prescribed diet need to be excluded.

Alternative treatment:

You do not have to be a part of this study to be treated.

Confidentiality:

Your identity will remain strictly confidential. Neither your name nor your baby's name will be published or disclosed to anyone outside the hospital.

Compensation:

Your doctors are covered by standard medical malpractice insurance. Nothing in this document restricts or curtails your rights.

Voluntary Participation:

You have volunteered to participate in this study. You may decide to withdraw from the study at any time. If you decide not to participate or if you subsequently decide to withdraw you will not be penalised and will not give up any benefits, which you had before entering the study.

Stopping the study:

You understand that your doctor may stop your participation in the study at any time without your consent.

Permission:
This research project has the Coombe Hospitals Research Ethics Committee approval.

Further information:
You can get more information or answers to your questions about the study, your participation in the study, and your rights, from Roslyn Tarrant (main researcher/investigator), who can be telephoned at 01-402 2888. If your doctor learns of important information that might affect your desire to remain in the study, he or she will tell you.

COOMBE WOMENS HOSITAL

CONSENT FORM

Title of research study:

'An investigation of the diet of the Irish infants from 0-6 months'.

Introduction:

This study and this consent form have been explained to me. My doctor has answered all my questions to my satisfaction. I believe I understand what will happen if I agree to be part of this study.

I have read, or had read to me, this consent form. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction. I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights. I have received a copy of this agreement and I understand that, if there is a sponsoring company, a signed copy will be sent to that sponsor.

PARTICIPANT'S NAME: ____

PARTICIPANT'S SIGNATURE: ____

DATE: ____

Date on which the participant was first furnished with this form: ____________________

Name of consenter or guardian: ____

Signature: ______________________________

Relation to my participant: ____

Statement of investigator's responsibility:
I have explained the nature, purpose, procedures, benefits, risks of, or alternatives to, this research study. I have offered to answer any questions and fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.

Physician's signature:

Date:

Appendix VIII

Self-administered Questionnaire 1: First contact with mothers

Also includes ante natal data and mothers contact details (see **Section D**) elicited from the mothers medical notes

Appendix IX

Interviewer-administered Questionnaire 2:

Second contact with mothers

Also includes biomedical data (see **Section B**) collected from mother and infant medical notes

Appendix X

Interviewer-administered Questionnaire 3:

Third contact with mothers

Appendix XI

a. Breastfeeding initiation and prevalence rates of National Mothers (n = 401)

	Hos. Dis.* % (n)	4-wks % (n)	6-wks % (n)	8-wks % (n)	12-wks % (n)	16-wks % (n)	20-wks % (n)	6-months % (n)
Exclusive breastfeeding	31.7 (127)	20.9 (84)	14.5 (58)	14.5 (58)	12.7 (51)	7.2 (29)	3.2 (13)	0.2 (1)
Predominant breastfeeding	0.5 (2)	0.5 (2)	0.7 (3)	0.7 (3)	0.5 (2)	0.2 (1)	0.0 (0)	0.0 (0)
Partial breastfeeding	6.5 (26)	7 (28)	9.2 (37)	8.5 (34)	7 (28)	9.2 (37)	8 (32)	9.4 (38)
‘Any’ breastfeeding	38.7 (155)	28.4 (114)	24.4 (98)	23.7 (95)	20.2 (81)	16.6 (67)	11.2 (45)	9.6 (39)

b. Breastfeeding initiation and prevalence rates of Non-National Mothers (n = 49)

	Hos. Dis.* % (n)	4-wks % (n)	6-wks % (n)	8-wks % (n)	12-wks % (n)	16-wks % (n)	20-wks % (n)	6-months % (n)
Exclusive breastfeeding	49 (24)	44.9 (22)	40.8 (20)	40.8 (20)	36.7 (18)	18.4 (9)	8.2 (4)	0.0 (0)
Predominant breastfeeding	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	0.0 (0)
Partial breastfeeding	26.5 (13)	28.6(14)	24.5(12)	24.5(12)	22.4(11)	34.7 (17)	38.8(19)	46.9(23)
‘Any’ breastfeeding	77.5 (38)	75.5 (37)	67.3 (33)	67.3 (33)	61.1 (30)	55.1 (27)	49 (24)	46.9 (23)

* Hos. Dis. denotes ‘hospital discharge’
wks denotes ‘weeks’

Appendix XII

Current Irish health system: ***'Care pathway for mothers from hospital discharge to professional community follow-up, through the first year of life'***

Referral from the maternity hospital to the Public Health Nurse (PHN).

↓

Protocol stipulates that a home visit is carried out during the first 48-hours post hospital discharge. If this is not possible, a telephone contact is necessary with an arrangement for a home visit. A post natal mother/infant assessment is conducted during the first contact with mothers.

↓

6-week post natal mother/infant assessment with the general practitioner (GP) includes weight monitoring & an assessment of the feeding history and progress.

↓

Infant vaccinations take place at 2, 4 and 6 months with the GP involving further contact with mothers.

↓

Developmental check-ups are carried out by the PHN at 3 and 6 months in the health centre.

Weaning information is initiated & verbally relayed (verbal & written) to mothers at the 3-month/12-week developmental check-up.

↓

Mothers are followed up again between 4 to 6 months in the health centre.

Weaning information is repeated and reiterated to mothers.
Mothers weaning knowledge is assessed by the PHN.
Breastfeeding mothers are given particular attention with regard to weaning.

PHN denotes 'public health nurse'
GP denotes 'general practitioner'

- ✓ The PHN is faxed from the maternity hospital (ward referral) post birth

- ✓ Mothers must be contacted by the PHN within 48-hours of hospital discharge either via a home visit, or a telephone call, with a follow-up visit arranged for following day.

- ✓ A post natal check up is carried out in the mother's home (home visit), during which an overall mother/baby assessment is conducted. This involves:
    1. An examination of infant/mothers diet, mother's mood, awareness of post natal depression symptoms
    2. Breastfeeding (correct technique, latching positions) or formula feeding (frequency and volumes of feeds) is discussed
    3. Information is collected on family history of metabolic disorders, any sibling history of note, hereditary conditions/allergy in the family are recorded.
    4. A 'Guthrie Test' is performed (heel prick blood test at home) to detect any metabolic disorders such as Phenylketonuria; this is a national necessity for all infants

        - ✓ 'High risk', younger and vulnerable mothers are noted and are referred to the 'Community Mothers' Scheme'; however this scheme is available to 'all' mothers

        - ✓ Particular attention is paid to first time and breastfeeding mothers. Infant weight pattern and mothers confidence determines the need for follow-up among these mothers

        - ✓ Breastfeeding mothers are requested to attend the health centre clinic on day 7 and 14 post birth for an infant weight check. If infant weight is appropriate, then follow-up is not necessary. The health centres have a weekly drop-in policy/weight clinic for weight checks for all infants

        - ✓ All infants have a post natal check up at 6-weeks with the GP or in some instances with the hospital paediatrician, during which, a thorough mother and infant assessment takes place. Vaccinations at 2, 4 and 6 months also entail a GP appointment/check-up.

Appendix XIII

Colour coded and consolidated responses for:
Snack options consumed by infants at six months (n = 235)

Snack options	Foods groups	n value
Bread & butter ± jam	Bread/butter ± jam	28
Ordinary biscuits e.g. Pink Biscuit Wafer, Shortbread biscuits, cookies, 'Nice' biscuits, Jaffa Cakes, Custard Creams, Marietta, Digestives, Jammy Dodgers, chocolate biscuits	Ordinary biscuits/cake e.g. cookies, pink wafer biscuits, shortbread biscuits	28
Cake e.g. Fancy cake, sponge cake	Ordinary biscuits/cake e.g. cookies, pink wafer biscuits, shortbread biscuits	3
Milky way bar, Dairy milk bar	Chocolate e.g. 'Milky bar', buttons, 'Dairy milk' bar	26
Chocolate buttons	Chocolate e.g. 'Milky bar', buttons, 'Dairy milk' bar	11
Baby rice cakes	Baby biscuits/baby rice cakes	16
Baby biscuits e.g. $^{\alpha}$ Heinz/*C&G	Baby biscuits/baby rice cakes	40
Rusk biscuit ± formula milk	'Liga'/Rusk +/- fruit with formula	81
Baby rice/commercial baby cereal	Commercial jar/packet of cereal/baby rice/egg custard & rice	6
Egg custard and rice jar	Commercial jar/packet of cereal/baby rice/egg custard & rice	4
Liga/whole	Liga/Rusk +/- fruit with formula	61
Tayto 'Snax' Crisps	Crisps	20
Fruit yoghurt	Baby yoghurt	4
Petit Filous yoghurt	Baby yoghurt	28
Danone baby yoghurt	Baby yoghurt	32
Goats milk yoghurt	Baby yoghurt	1
Mashed banana bits	Fruit/vegetable stick e.g. carrot banana bits, mango, apple, watermelon	16
Sliced apple	Fruit/vegetable stick e.g. carrot banana bits, mango, apple, watermelon	10
Mango with yoghurt mashed	Fruit/vegetable stick e.g. carrot banana bits, mango, apple, watermelon	2

Appendix XIII continued → Snack options consumed by infants at 6-months

Snack options	Foods groups	n value
Water melon mashed	Fruit/vegetable stick e.g. carrot banana bits, mango, apple, watermelon	5
Commercial baby fruit puree (jar/packet)	Fruit/vegetable stick e.g. carrot banana bits, mango, apple, watermelon	17
Cheese cubes	Fruit/vegetable stick e.g. carrot banana bits, mango, apple, watermelon	1
Carrot stick	Fruit/vegetable stick e.g. carrot banana bits, mango, apple, watermelon	2
Lollipop	Ice cream/jelly/lollipop	1
Vanilla ice-cream	Ice cream/jelly/lollipop	5
Total		**448**

*C&G denotes 'Cow and Gate' infant feeding company

$^{\alpha}$ Heinz Baby Food is a company that manufactures infant-specific weaning foods

Appendix XIV

Colour coded and consolidated responses pertaining to: 'First foods offered to infants' (n = 400)

First food:	Food grouped	n value
Baby rice	Pureed baby rice	238
Organic baby rice	Pureed baby rice	1
Commercial jar of pureed fruit	Commercial baby jar of fruit puree	4
'Sunshine orange' breakfast cereal	Commercial baby sweetened cereal/dessert	40
Creamed baby porridge	Commercial baby sweetened cereal/dessert	19
Commercial jar of pureed baby custard	Commercial baby sweetened cereal/dessert	3
Commercial oat and apple cereal	Commercial baby sweetened cereal/dessert	2
Semolina with honey ([&]Milupa)	Commercial baby sweetened cereal/dessert	1
Farley's banana custard jar	Commercial baby sweetened cereal/dessert	1
Rusk mashed with formula milk	Commercial baby sweetened cereal/dessert	9
Creamed rice pudding	Commercial baby sweetened cereal/dessert	3
Egg custard with rice	Commercial baby sweetened cereal/dessert	18
7-cereals breakfast cereal	Commercial baby sweetened cereal/dessert	1
Commercial jar of meat/vegetable-based e.g. sweet/sour chicken	Commercial baby vegetable & meat mixed	4
Commercial jar of vegetable-based puree e.g. butternut squash	Commercial baby jar of vegetable-based puree	9
'Petit Filous'	Baby yoghurt	6
'Danone' baby yoghurt	Baby yoghurt	3
Mashed potato with butter	Home-prepared vegetable puree e.g. carrot/sweet potato	5
Sweet potato puree (home-prepared)	Home-prepared vegetable puree e.g. carrot/sweet potato	1
Home-prepared pureed carrot	Home-prepared vegetable puree e.g. carrot/sweet potato	11
Home-prepared vegetable puree	Home-prepared vegetable puree e.g. carrot/sweet potato	5
Home-prepared soup	Home-prepared vegetable puree e.g. carrot/sweet potato	1
Mashed banana	Home-prepared fruit puree	5
Home-prepared stewed fruit/pear/apple	Home-prepared fruit puree	7
'Weetabix' mixed with formula milk	Ordinary adult cereals e.g. 'Weetabix'/'Ready Break'	1
'Ready Brek' breakfast cereal	Ordinary adult cereals e.g. 'Weetabix'/'Ready Break'	2
Total		**400**

[&] Milupa is a company that manufactures infant-specific weaning foods

Appendix XV

Colour coded and consolidated responses pertaining to:
'Breakfast options consumed by infants at six months' (n = 385)

Breakfast options	Foods grouped	n value
Sunshine Orange Cereal (&Milupa)	Commercial baby cereal cereal/dessert +/- fruit	118
Oat/Apple Cereal (&Milupa)	Commercial baby cereal cereal/dessert +/- fruit	62
Sunripe Banana (&Milupa)	Commercial baby cereal cereal/dessert +/- fruit	62
Creamed Porridge (&Milupa)	Commercial baby cereal cereal/dessert +/- fruit	71
7-Cereals (&Milupa)	Commercial baby cereal cereal/dessert +/- fruit	27
*C&G Fruity Breakfast	Commercial baby cereal cereal/dessert +/- fruit	8
*C&G Creamed Oat Porridge	Commercial baby cereal cereal/dessert +/- fruit	48
*C&G Fruit Muesli	Commercial baby cereal cereal/dessert +/- fruit	17
Organic Baby Porridge (all brands included)	Commercial baby cereal cereal/dessert +/- fruit	14
+Farley's Cereal Variety	Commercial baby cereal cereal/dessert +/- fruit	3
Pure baby rice (all brands included)	Commercial baby cereal cereal/dessert +/- fruit	44
Baby porridge (all brands included)	Commercial baby cereal cereal/dessert +/- fruit	83
Baby porridge with fruit puree/or with mashed banana	Commercial baby cereal cereal/dessert +/- fruit	21
$^{\alpha}$Heinz baby porridge/'creamy oat porridge'	Commercial baby cereal cereal/dessert +/- fruit	15
Baby Rice pudding (all brands included)	Commercial baby cereal cereal/dessert +/- fruit	6
+Farley's Fruit and Yoghurt Mix	Commercial baby cereal cereal/dessert +/- fruit	5
Jar of egg custard and rice ($^{\alpha}$ Heinz)	Commercial baby cereal cereal/dessert +/- fruit	7
Semolina and rice (all brands included)	Commercial baby cereal cereal/dessert +/- fruit	1
Spelt baby porridge/with fruit	Commercial baby cereal cereal/dessert +/- fruit	2
Ordinary adult porridge oats (all brands included)	Adult cereal e.g. cornflakes/rice crispies, Shreddies, Weetabix	12
Ready Brek	Adult cereal e.g. cornflakes/rice crispies, Shreddies, Weetabix	54
Cornflakes/Rice Crispies (ordinary)	Adult cereal e.g. cornflakes/rice crispies, Shreddies, Weetabix	4
Weetabix (x1)	Adult cereal e.g. cornflakes/rice crispies, Shreddies, Weetabix	53
Blended Shreddies/Shredded Wheat cereal	Adult cereal e.g. cornflakes/rice crispies, Shreddies, Weetabix	1
Jarred baby fruit puree (all brands included)	Commercial baby food jar of fruit	8

Appendix XV continued →

'Breakfast options consumed by infants at 6-months'	**Foods grouped**	**n value**
Home-prepared fruit puree preparation with baby rice	Home-prepared fruit puree preparation	21
Home-prepared fruit puree preparation	Home-prepared fruit puree preparation	22
Mashed banana	Home-prepared fruit puree preparation	7
Home-prepared: mashed avocado with banana	Home-prepared fruit puree preparation	1
Toast with butter	Toast with butter/egg on toast	8
Home-prepared boiled egg with butter	Toast with butter/egg on toast	2
Petit Filous/with banana	Baby yoghurt with/without fruit	8
Danone Baby Yoghurt	Baby yoghurt with/without fruit	7
Fruit mixed with Danone baby yoghurt	Baby yoghurt with/without fruit	2
Liga/Rusk with fruit mixed	Rusk/Liga with/without fruit mixed	6
Liga/Rusk mashed with formula	Rusk/Liga with/without fruit mixed	35
Total		**865**

*C&G denotes 'Cow and Gate' infant feeding company
[&]Milupa, [α] Heinz Baby Food, and [+]Farley's are companies that manufacture infant-specific weaning foods

Appendix XVI

Colour coded and consolidated responses for:
‘Lunch options consumed by infants at six months’ (n = 382)

Lunch options	Foods grouped	n value
*C&G ‘Vegetable & Chicken Risotto’	Commercial baby prepared jar/packet: meat & vegetable	18
*C&G ‘Mrs. MacLachlans Mediterranean Vegetable & Lamb Risotto’	Commercial baby prepared jar/packet: meat & vegetable	22
*C&G ‘Rosies Orchard Chicken’	Commercial baby prepared jar/packet: meat & vegetable	21
*C&G ‘Potato & Pork Provencal’	Commercial baby prepared jar/packet: meat & vegetable	27
‘Mums Own Range’ $^{\alpha}$ Heinz: meat and vegetable-based e.g. chicken & vegetable casserole, Caribbean casserole with pork, pot & beef	Commercial baby prepared jar/packet: meat & vegetable	16
*C&G ‘Spring Vegetable & Chicken’	Commercial baby prepared jar/packet: meat & vegetable	6
&Milupa ‘Country Chicken & Vegetables’	Commercial baby prepared jar/packet: meat & vegetable	29
&Milupa ‘Country Chicken & Vegetables’	Commercial baby prepared jar/packet: meat & vegetable	23
&Milupa ‘Turkey & Vegetable Dinner’	Commercial baby prepared jar/packet: meat & vegetable	28
&Milupa ‘Harvest Vegetable & Chicken Dinner’	Commercial baby prepared jar/packet: meat & vegetable	15
& Milupa ‘Lamb Casserole’	Commercial baby prepared jar/packet: meat & vegetable	25
$^{\alpha}$ Heinz Jar 'Commercial' dinner/meat/vegetable/pots e.g. pork casserole, vegetable & chick casserole, carrot & lamb	Commercial baby prepared jar/packet: meat & vegetable	75
Organic $^{\alpha}$ ‘Heinz Spaghetti Bolognaise’	Commercial baby prepared jar/packet: meat & vegetable	7
^ HIPP Organic meat variety: meat/pork/chicken & vegetable	Commercial baby prepared jar/packet: meat & vegetable	13
*C&G ‘Cauliflower Cheese Special’	Commercial baby prepared jar/packet: vegetable-based	18
Butternut Squash Puree (all brands included)	Commercial baby prepared jar/packet: vegetable-based	19
& Milupa ‘Vegetable Risotto’	Commercial baby prepared jar/packet: vegetable-based	44
& Milupa ‘Orchard fruit & Carrot’	Commercial baby prepared jar/packet: vegetable-based	11
& Milupa ‘Cauliflower & Creamed Potato’	Commercial baby prepared jar/packet: vegetable-based	19
& Milupa ‘Vegetable Risotto’	Commercial baby prepared jar/packet: vegetable-based	23
Commercial dinner/vegetable-based e.g. sweet potato, butternut squash	Commercial baby prepared jar/packet: vegetable-based	21
$^{\alpha}$ Heinz jar 'Vegetable'-based e.g. sweet potato and vegetables, carrot and potato, vegetable casserole	Commercial baby prepared jar/packet: vegetable-based	32

Appendix XVI continued → Lunch options consumed by infants at six months (n = 382)

Lunch options consumed by infants at 6-months	Foods grouped	n value
Organic [α]Heinz 'Cheesy Carrot, Cauliflower and Potato'	Commercial baby prepared jar/packet: vegetable-based	6
^ HIPP Organic vegetable option e.g. carrots & potatoes,	Commercial baby prepared jar/packet: vegetable-based	10
Home-prepared chicken/turkey and vegetable dinner (baby modified)	Home-prepared: 'Baby Modified' meat/fish & vegetable puree	107
Home-prepared lamb and vegetable dinner (baby modified)	Home-prepared: 'Baby Modified' meat/fish & vegetable puree	19
Home-prepared fish (e.g. mashed fish finger, trout, salmon flakes, sole) & vegetable dinner (baby modified)	Home-prepared: 'Baby Modified' meat/fish & vegetable puree	14
Home-prepared sausage & vegetable dinner, pots (baby modified)	Home-prepared: 'Baby Modified' meat/fish & vegetable puree	5
Home-prepared minced meat, vegetable, potato (baby modified)	Home-prepared: 'Baby Modified' meat/fish & vegetable puree	46
Home-prepared vegetable-based dinner (broccoli, courgettes, sweet potato, carrots, swede) combinations e.g. squash, courgette/pot, carrot/parsnip (baby modified)	Home-prepared: 'Baby Modified' vegetable-based puree	168
Home-prepared beans with rice mashed/dahl or lentil-based meal	Home-prepared: 'Baby Modified' vegetable-based puree	3
Home-prepared 'Quinoa & Vegetables'	Home-prepared: 'Baby Modified' vegetable-based puree	1
Home-prepared vegetable dinner: soya beans/butter beans with vegetables	Home-prepared: 'Baby Modified' vegetable-based puree	2
'Baby unmodified' home-prepared soup; oxtail, vegetable-based e.g. potato & leek, chicken & vegetable.	Home-prepared: 'Baby Unmodified' vegetable/meat-based meal e.g. with gravy/oxtail soup, black bean sauce, coddle	25
'Baby unmodified' family meal e.g. coddle, spaghetti, lasagne, Shepherd's pie, bolognaise sauce, stew, chicken with black bean sauce	Home-prepared: 'Baby Unmodified' vegetable/meat-based meal e.g. with gravy/oxtail soup, black bean sauce, coddle	51
Home-prepared 'mashed potato and gravy'	Home-prepared: 'Baby Unmodified' vegetable/meat-based meal e.g. with gravy/oxtail soup, black bean sauce, coddle	53
Home-prepared 'sausage, potato with gravy'	Home-prepared: 'Baby Unmodified' vegetable/meat-based meal e.g. with gravy/oxtail soup, black bean sauce, coddle	10
'Smash' (instant potato mash mix) with vegetables & gravy	Home-prepared: 'Baby Unmodified' vegetable/meat-based meal e.g. corned beef, garlic bread, with gravy/oxtail soup, black bean sauce, 'smash' instant potato mash mix, coddle	1
Tin of Irish Stew/corned beef	Home-prepared: 'Baby Unmodified' vegetable/meat-based meal e.g. corned beef, garlic bread, with gravy/oxtail soup, black bean sauce, 'smash' instant potato mash mix, coddle	2

Appendix XVI continued → Lunch options consumed by infants at six months (n = 382)		
Lunch options consumed by infants at 6-months	**Foods grouped**	**n value**
Garlic bread	Home-prepared: 'Baby Unmodified' vegetable/meat-based meal e.g. corned beef, garlic bread, with gravy/oxtail soup, black bean sauce, 'smash' instant potato mash mix, coddle	2
Ordinary adult waffles with beans mashed	Other: baby sweetened cereal, baked beans, potato waffles, rusk & formula	3
Home-prepared 'baked beans' or tinned spaghetti/mashed with potato/vegetables	Other: baby sweetened cereal, baked beans, potato waffles, rusk & formula	5
Type of sweetened baby cereal (all brands included)	Other: baby sweetened cereal, baked beans, potato waffles, rusk & formula	3
Liga mashed with formula milk	Other: baby sweetened cereal, baked beans, potato waffles, rusk & formula	1
Home-prepared scrambled egg/mashed with vegetables & potatoes	Home-prepared egg dish	3
Total		**1052**

* C&G denotes 'Cow and Gate' infant feeding company

$^{\alpha}$ Heinz Baby Food, $^{\&}$Milupa and ^ HIPP Organic Baby Food are companies that manufacture infant-specific weaning foods

Appendix XVII

Colour coded and consolidated responses for:
Evening meal options consumed by infants at six months (n = 355)

Evening meal options consumed at six months	Foods grouped	n value
Rusk mashed with formula milk	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	61
Rusk mashed with fruit/pear/banana	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	9
Rusk with cows milk	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	1
Liga mashed with water/formula	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	42
Ordinary custard	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	6
Baby rice/with-without fruit puree	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	53
[&]Milupa fruit salad	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	25
[&]Milupa Semolina & Honey	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	19
[&]Milupa Rusk with mixed fruit	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	6
[&]Milupa Rusk with pear	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	5
[&]Milupa Cookie Crumble	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	15
[&]Milupa Milk Pudding & Chocolate chip	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	12
*C&G Traditional Rice Pudding	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	32
*C&G Banana & Apple Custard	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	18

Appendix XVII continued → Evening meal options consumed by infants at 6-months

Evening meal options consumed at six months	Foods grouped	n value
*C&G Dutch Apple Pudding	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	7
Chocolate Orange dessert	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	8
$^{\alpha}$ Heinz custard and apple/banana dessert	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	24
Strawberry fool dessert	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	8
Baby custard/unknown brand	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	10
Sunshine orange Cereal	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	15
$^{\alpha}$ Heinz Egg custard with rice	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	62
Ambrosia rice pudding	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	11
Creamed porridge jar	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	10
Baby apple crumble	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	1
Ordinary/non-baby 'Devon' Custard	Commercial baby jar/packet of dessert/cereal e.g. apple pudding, cookie crumble, fruit salad	1
Home-prepared fruit puree/apple & pear, apple & peach	Home-prepared fruit puree	98
Mashed banana	Home-prepared fruit puree	46
Petit Filous Yoghurt	Yoghurt (baby yoghurt/ordinary yoghurt) with/without fruit	69
‘Danone’ baby yoghurt	Yoghurt (baby yoghurt/ordinary yoghurt) with/without fruit	61
Fruit puree with natural yoghurt	Yoghurt (baby yoghurt/ordinary yoghurt) with/without fruit	5
Pureed fruit with baby yoghurt	Yoghurt (baby yoghurt/ordinary yoghurt) with/without fruit	23
Ordinary fruit yogurt e.g. strawberry, peach flavours	Yoghurt (baby yoghurt/ordinary yoghurt) with/without fruit	10
Goats milk yoghurt	Yoghurt (baby yoghurt/ordinary yoghurt) with/without fruit	2
Baby rice with home-prepared pureed vegetables	Home-prepared vegetable puree/non-meat tea	9

Appendix XVII continued → Evening meal options consumed by infants at 6-months

Evening meal options consumed at six months	**Foods grouped**	**n value**
Mashed beans/home-prepared	Home-prepared vegetable puree/non-meat tea	2
Tinned spaghetti mashed up	Home-prepared vegetable puree/non-meat tea	1
Mashed egg/hard boiled/or scrambled eggs	Home-prepared vegetable puree/non-meat tea	4
Pureed vegetable/home-prepared	Home-prepared vegetable puree/non-meat tea	24
Commercial jar meat with vegetable	Commercial jar/packet of meat	18
Weetabix /Ready Brek /with cows milk	Adult cereal e.g. 'Weetabix'/'Ready Brek'	9
Comm. jar pear/peach puree	Commercial jar/packet of fruit puree	35
Comm. jar stewed apple	Commercial jar/packet of fruit puree	21
α Heinz fruit dessert e.g. banana/apple, strawberry/apple	Commercial jar/packet of fruit puree	12
Home-prepared pureed vegetables with chicken	Home-prepared vegetable & meat puree	10
Tayto 'Snax' Crisps (full bag)	Home-prepared 'Baby Unmodified' adult snacks meals e.g. soup, gravy & potatoes, crisps, biscuits	1
Bread/with butter and jam	Home-prepared 'Baby Unmodified' adult snacks meals e.g. soup, gravy & potatoes, crisps, biscuits	1
Blended biscuits (e.g. 'Digestive') mixed with cows milk/pureed fruit	Home-prepared 'Baby Unmodified' adult snacks meals e.g. soup, gravy & potatoes, crisps, biscuits	3
Ordinary chicken soup from a tin with pieces of white bread	Home-prepared 'Baby Unmodified' adult snacks meals e.g. soup, gravy & potatoes, crisps, biscuits	2
Unmodified family meal: lamb/chicken casserole, Shepherd's Pie, ordinary gravy mashed with meat and potatoes.	Home-prepared 'Baby Unmodified' adult snacks meals e.g. soup, gravy & potatoes, crisps, biscuits	6
Total		**933**

* C&G denotes 'Cow and Gate' infant feeding company

&Milupa and α Heinz Baby Food are companies that manufacture infant-specific weaning foods

Appendix XVIII

Colour coded and consolidated responses for:
Dessert options consumed by infants at six months (n = 169)

Dessert options	**Foods grouped**	**n value**
[α] Heinz ‘Egg custard with rice’	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	13
Commercial ([&]Milupa/*C&G) baby creamed rice pudding	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	16
*C&G/[&]Milupa fruit salad	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	7
Jar of egg custard with rice (brand type not elicited)	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	12
*C&G ‘Chocolate pudding’ jar dessert	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	2
Semolina and honey ([&]Milupa)	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	3
Apple and banana custard	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	7
[&]Milupa ‘Cookie Crumble Dessert’	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	7
Ambrosia rice pudding	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	3
Baby apple crumble dessert	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	2
Strawberry & Cream Mix dessert	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	5
[&]Milupa Milk Pudding with Chocolate Chip	Commercial jar/packet of dessert e.g. egg custard & rice/fruit salad/cookie crumble/semolina & honey/apple & banana	2
Natural yoghurt mixed with fruit	Yoghurt (natural/baby) with/without fruit	3
Petit Filous	Yoghurt (natural/baby) with/without fruit	47
Danone Baby Yoghurt	Yoghurt (natural/baby) with/without fruit	49

Appendix XVIII continued → Dessert options consumed by infants at 6-months

Dessert options	Foods grouped	n value
Petit Filous with fruit	Yoghurt (natural/baby) with/without fruit	3
Home-prepared natural yoghurt	Yoghurt (natural/baby) with/without fruit	1
Home-prepared fruit puree	Home-prepared fruit puree	39
Mashed banana	Home-prepared fruit puree	12
Grated apple	Home-prepared fruit puree	2
Liquidized prunes	Home-prepared fruit puree	1
Liga/Rusk whole or with formula milk	Liga/Rusk with added formula milk	9
Ordinary (adult) jelly and/or ice-cream	Adult desserts e.g. jelly/ice cream/blended biscuits	5
Blended biscuits (digestive biscuits)	Adult desserts e.g. jelly/ice cream/blended biscuits	2
Commercial jar of fruit puree preparation e.g. melon/peach puree	Commercial jar/packet of fruit puree	27
Total		**279**

* C&G denotes ‘Cow and Gate’ infant feeding company

$^{\alpha}$ Heinz Baby Food and $^{\&}$Milupa are companies that manufacture infant-specific weaning foods

Appendix XIX

General guidelines for reducing energy intake in children

Avoid fried foods including chips, crisps as well as added fat during cooking

Remove visible fat from meat and choose low fat products e.g. low fat mince

Use butter and margarine sparingly on bread and crisp bread; a low fat spread is preferable

Do not add butter or alternatives to foods e.g. cooked vegetables

Avoid adding sugar to foods and drinks. An energy free artificial sweetener e.g. aspartame may be used if required

Exclude as far as practical: chocolate, sweets, cakes and biscuits

Offer vegetables or salad at each meal

Use fruit (fresh, frozen, tinned in natural juices), low energy yoghurt and sugar free jelly in place of desserts

Use low energy drinks and squash

Adapted from: Shaw & Lawson (2007) ‘Clinical Paediatric Dietetics’

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

Infant feeding Study

Questionnaire 1

<u>All the information in this questionnaire is strictly confidential</u>.

SECTION A **(Please tick)**

1. **Do you have other children?** Yes ____ No ____

   ↓

If No, please continue to question 3

How many other children do you have?

____

Please indicate how they were fed as infants:

Child 1 Breastfed ☐ Bottle-fed formula milk ☐ If breastfed, for how long? _____

Child 2 Breastfed ☐ Bottle-fed formula milk ☐ If breastfed, for how long? _____

Child 3 Breastfed ☐ Bottle-fed formula milk ☐ If breastfed, for how long? _____

Child 4 Breastfed ☐ Bottle-fed formula milk ☐ If breastfed, for how long? _____

Other: Breastfed ☐ Bottle-fed formula milk ☐ If breastfed, for how long? _____

2. **Were you happy with this infant feeding method?** Yes ☐ No ☐

Please mention why? ____

____

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

3. Which infant feeding method do you think is more beneficial for babies?

Bottle-feeding with formula milk is better…….. ☐

Breastfeeding is better…………………………. ☐

No difference between the two………………….☐

Don't know…………………………………….. ☐

Why do you think this infant feeding method is better? (Detail if possible)

____

____

4. I received most of my infant feeding information from: (Tick as many as you wish)

Mother…………………☐ Mother-in-law………..☐
Friends…………………☐ Sister……………….....☐
Sister-in-law…………… ☐ Midwives in hospital…☐
GP………………………☐ Public health nurse…...☐
Dietitian…………………☐ Ante-natal classes……. ☐
Parent craft classes………☐ Magazine/book………..☐
TV ………….……….…..☐ Internet…………………☐
Remember from school e.g. biology class, home economics………..☐
Other ______________________________________

5. At what age/month do you think solid food/spoon feeds should be introduced?

____

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

6. Have you ever seen a mother breastfeed her baby? Yes □ No □

7. Who have you seen breastfeed? (Tick as many as you wish)

Mother……………………….. □
Mother-in-law……………….. □
Sister…………………………..□
Sister-in-law………………….. □
Aunt…………………………… □
Friend …………………………. □
Stranger breastfeeding in public. □
Other, please mention _______________________

8. Do you think breastfeeding in front of others for you, would be:

Natural…………………….□
Embarrassing ……………..□
Pleasant …………………...□
Offensive ………………… □
Positive…... ……………….□
Distasteful …………………□
Other, please mention__________________________________

9. For you personally, do you think it would be acceptable to breastfeed:

At home with your partner present…..……..Yes □		No □
With other men present………….....………..Yes □		No □
At home with your family present …………Yes □		No □
With other children present ………..………..Yes □		No □
In a restaurant……………………..…………Yes □		No □
In a shopping centre………….……………..Yes □		No □
On a public bus…. …………………………Yes □		No □
In public park…………………..……………Yes □		No □

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

10. When your baby is born, do you intend to:

Bottle-feed infant formula milk □ →……**Please go to question 11**

Breastfeed □ →………………………. **Please go to question 12**

Combined feeding – breast-feeding and bottle-feeding formula feed □ → **Please go to question 13**

Not sure yet □ →……………………… **Please go to question 14**

11. What are the main reasons you chose to bottle-feed?

____

____

When did you make this decision? (Please tick time as near as possible)

Before pregnancy ………. □ Middle of pregnancy……..□

Beginning of pregnancy….□ End of pregnancy………...□

Did you consider breastfeeding? Yes □ No □

What are your main reasons for not choosing to breastfeed?

____

____

→ **Please continue to question 14**

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

12. What are the main reasons you chose to breastfeed?

____

____

When did you make this decision?
(Please tick time as near as possible)

Before pregnancy………..☐ Middle of pregnancy……...☐
Beginning of pregnancy…☐ End of pregnancy…………☐

For how long do you plan to breastfeed?

____

→ Please continue to question 14

13. What are the main reasons you chose this method of feeding for your infant?

____

____

→ Please continue to question 14

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

14. Who/which of the following have influenced your infant feeding choice? (Tick as many as you wish)

Your mother……………….☐ Mother-in-law……………. ☐
Sister……………………… ☐ Sister-in-law……………….☐
Family tradition……………☐ Friends……………………. ☐
Partner…………………….. ☐ Pediatrician…………………☐
Midwives in hospital……… ☐ Public health nurse…………☐
GP…………………………..☐ Hospital staff……………… ☐
Dietitian…………………….☐ Internet……………………..☐
Book/magazine…………….☐ TV…………………………......☐
Internet…………………...☐
Other, please mention________________________________

15. How were you fed as a baby?

Bottle-fed with formula milk…….. ☐

Breastfed…………………………..☐

Combination of these…………….. ☐

Don't know………………………..☐

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

SECTION B

1. a.) Have you attended ante natal or/and parent craft classes?

One…………….. □

More than one….. □→ **Please mention how many attended___**

None…………… □ → **Please continue to question 3**

2. Did these classes give you satisfactory information on:

Formula feeding…………Yes □ No □

Breastfeeding……………Yes □ No □

3. Which of the following statements would you most agree with?

a.) ' My friends breastfeed their infants' **<u>(Please tick one of the following</u>)**

Most □ Some □ None □

b.) ' In general, my friends' experiences with breastfeeding their infants have been:'

Very satisfactory □ Satisfactory □ Indifferent □ Not satisfactory □

c.) 'My friends feed their infants formula milk' **<u>(Please tick one of the following)</u>**

Most □ Some □ None □

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

4. With regard to smoking, please tick one of the following:

'I have never smoked' ……………………□ → Please continue to question 6

'I used to smoke, and gave up over a year ago'..□→Please continue to Q.6

'I gave up smoking when I found out I was pregnant'…□→Please continue to Q.6

'I am currently smoking'…………………□ → Please continue to question 5

5. a.) How many cigarettes do you currently smoke per day? __________

b.) How many cigarettes did you smoke before the pregnancy? ______

6. Are you drinking any alcohol during this pregnancy? Yes □ No □

↓

If No, please continue to Part C

7. If yes, how much do you drink per week:

	Currently:	**Before the pregnancy:**
Glasses of wine per week:		
Pints of beer, lager, stout per week:		
Number of 'Alco pop' drinks (bottled-flavoured alcoholic drinks) per week:		
Number of shots per week (measures) e.g. rum, vodka		

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

SECTION C

1. **What is your occupation?** (If you are a student, please mention if you are full time or part-time) ___________________________________

2. **What level of education did you complete?** (Please tick)

   Primary school______
   Secondary school_______

   Training course (e.g. hairdresser, FAS, VEC, apprentice) ___________
   Third Level
   Primary Degree_________
   Post-graduate ______
   Other, please mention ______________________________________

3. **Do you have a partner?**

   Yes □ ↓ **If Yes, please go to question 4**

   No □ ↓ **If No, please go to question 10**

4. **How old is your partner?** ____________

5. **What is your partner's occupation?** (If a student, please mention part-time or full-time) _____________________________________

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

6. What level of education did your partner complete?

Primary school _____
Secondary school ______

Training course (e.g. FAS, VEC, apprentice, mechanic, carpenter) ____
Third Level
Primary Degree _____
Post-graduate _____
Other, please mention

____

7. Have you discussed how you will feed your baby with your partner?

Yes ☐ No ☐

8. a.) What method of infant feeding, if any, does your partner prefer?

____

b.) Does your partner attend ante-natal and/or parent craft classes with you?

Yes ☐ No ☐

9. Does your partner's attitude affect your infant feeding choice?

Yes ☐ No ☐

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

10. What is your current living arrangement/situation?

Married, living with husband………………☐
Married, not living with husband………… ☐
Not married, living with partner…………... ☐
Partnered, but not living together…………..☐
Single, living with parents………………….☐
Single, living alone…………………………☐
Divorced……………………………………☐
Widowed……………………………………☐

11. Do you live?

In your own home……………☐
With your parents…………….☐
With your parents-in-law…….☐
Rented accommodation………☐
Apartment…………………….☐
Mother's shelter ……………...☐
Other, please mention ________________________________

12. Do you plan to return to work after the birth? Yes ☐ No ☐
↓

If No, Please continue to Question 15

13. If so, how long after the birth do you intend to return to work?

____

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

14. Do you think going back to work will influence how you will feed your baby?

Yes ☐ No ☐

In what way, please mention__________________________________

____

15. a.) What is your height? ________________

b.) What was your pre-pregnancy weight?___________________

16. a.) What is the baby's father's height? ______________________

b.) What is the baby's father's weight? ______________________

17. Is this pregnancy:

Planned ☐ Unplanned ☐

18. How do you feel about the pregnancy at this point? (Please select one)

Very happy ☐ Quite happy ☐ Indifferent ☐ Not happy ☐

Not happy at all☐

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

19. Supplementation during pregnancy

Have you, or are you currently taking any nutritional/dietary supplements during this pregnancy:

(Please tick)

a.) No supplements (e.g. Folic acid, Iron) taken during the pregnancy…☐

b.) Folic acid………. ☐ When started __________________
How much taken per day/brand:
____

c.) Iron…………… ☐ When started ___________________
How much taken per day/brand
____

d.) Combined Iron/Folic acid supplement…….. ☐ When started ________
How much taken per day/brand
____

d.) Vitamin/Mineral supplement……………….. ☐ When started ______
How much taken per day/brand
____

e.) Vitamin D/Calcium………………………... ☐ When started ______
How much taken per day/brand ______________

f.) Other e.g. herbal remedies, cod liver oil, homeopathic etc.
____

When started ________________ How much taken per day/brand _____

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

SECTION D

To be filled in by the investigator as per mother's medical notes

1.) **Hospital number:** ____

2.) **Mothers name:** ____

3.) **Address:** ____

____

____

4.) **Mothers country of birth:** ______________________________________

5.) **Age:** ____

6.) **Telephone Contact numbers- a.) Mobile number:** ____________________

b.) Home number: _____________________

7.) **Mother's Ethnicity/Race:** _________________

8.) **Father's ethnicity/Race:** __________________

9.) **Gestational week of mum's first antenatal visit:** _____________________

10.) **Measurements:** **GP DETAILS**

Hb level on admission (antenatal)	**Hb level at 32-weeks**

11.) **Folic Acid History:**

____

____

To be filled in by the investigator of study: **DATE MOTHER DUE:**

Date Gestational week of mother

Study number Public/Semi-private/Private

SECTION E: Diabetic Clinic

1.)

a.) Insulin-dependant diabetic……..□

b.) Gestational diabetic……………□
When diagnosed/No. of weeks antenatal: ____________________

Previous gestational diabetes? Yes □ No □

Treatment

2.)

Diet-controlled □

Insulin □

Diabetic Control

3.) Most recent HbA1c level in third trimester__________Week taken: ___________

Date: **Age of infant 6 weeks + ______days** **Study No.**

Infant feeding Study

Second Interview: Interview at 6-weeks post birth

SECTION A: FOR ALL MOTHERS

1. How are you currently feeding your baby? (*establish the current feeding status)

a) * Exclusively breastfeeding-
(Solely breast milk, vitamins/minerals, medicines) ___→

b) * Predominantly breastfeeding
(Breast milk with non-nutritive drinks e.g. juices, water, herbal teas, vitamins and minerals, medicines) ______ →

*** For all breast feeders:**

Do you express your breast milk?

Yes _____ No ______

c) * Partially breastfeeding (combined breast milk with bottle-feeding formula milk and/or solid foods)

---

d)** Fully formula feeding _____ →

d1) How many feeds taken in 24hrs (frequency) ?__________________

d2) Volume of feed consumed per day approx. (mls) ______________

2. Fully formula feeders:

a.) Current formula name: ______________

b.) Whey based ___ Casein based ____

c.) To date, number of different formulas tried: ______________

d.) Reason for changing formula type:

____

____

Date: **Age of infant 6 weeks + ______days** **Study No.**

3. When did you make this infant feeding decision?

Before pregnancy……..☐
During pregnancy……..☐
At the birth…………….☐
After the birth…………☐

4. Who was/were the most influential person/s in making this infant feeding choice?

Paediatrician…………..☐	Mother………………☐
Obstetrician…………....☐	Mother-in-law……….☐
Hospital staff………….☐	Sister…………………☐
Midwives in hospital…..☐	Sister-in-law…………☐
Public health nurse…….☐	Friends……………….☐
Dietitian………………..☐	Ante-natal/parent craft class…☐
Partner…………………☐	Self/Personal…………☐
Other_________________	Advertisements………☐

5. Did you have your baby by your side while in hospital (rooming-in)?

Yes ☐ No ☐

6. How many days did you spend in hospital after the delivery, before going home? ____

7. Were you happy with the amount of time you had in the hospital after the delivery to establish successful feeding?

Yes ☐ No ☐

Date: **Age of infant 6 weeks + ______days** **Study No.**

8. **Do you feel you needed assistance from the midwives to establish successful feeding while in the hospital?**

Yes □ No □

Go to question 10

9. **If yes, did you get this assistance?**

a.) Yes ____ No ____ → **If no, why not?**

____

↓

b.) If yes, how satisfied were you with this assistance?

Very satisfied □ Satisfied □ Neither satisfied nor dissatisfied □ Not satisfied □ Not satisfied at all □

c.) **If dissatisfied, reason:**

____

10. **a.) What method of infant feeding, if any, did your partner encourage?**

Breastfeeding □ Bottle-feeding □ Combination feeding □
No preference of feeding method □ Unsure/Never discussed

b.) For what reason did he choose this feeding method?

____

11. **What method of infant feeding, if any, did your own mother encourage?**

Breastfeeding □ Bottle-feeding □ Combination of both □

No preference of feeding method □ Unsure/Never discussed

Date: **Age of infant 6 weeks + ______days** **Study No.**

FOR ALL MUMS

12. Did you start or attempt breastfeeding after the birth?

Yes ______ **No ______ → GO to question 21**

If Yes: For all mums <u>who initiated breastfeeding:</u>

13. a.) Was your breast milk the infant's first feed?

Yes ___ No ____

↓ **What was the reason for this?**

____

b.) Did you have skin-to-skin contact with your baby after the birth?

Yes ___ No___- Reason: ______________

c.) How long after the birth did you start breastfeeding? ______________

14. For how long did you breastfeed/total duration since birth:

a.)No. of days Exclusively Breastfeeding: ______________________________

b.)No. of days Predominantly Breastfeeding: ____________________________

c.)No. of days Partially Breastfeeding: ________________________________

If mum has stopped breastfeeding→ Go to question 15 and continue….

If mum is still breastfeeding→ Go to question 16 and continue…

MOTHERS WHO STOPPED BREASTFEEDING

15. **** If mum <u>discontinued</u> breastfeeding following initiation:**

a.) What were the reasons for stopping?

____

____

____

b.) Were you happy to stop breastfeeding at this time?

YES _____ NO ____

↓ ↓

Continue to question 16 Why not?

____

____

→ Continue to question 16

Date: **Age of infant 6 weeks + ______days** **Study No.**

ALL MUMS WHO INITIATED BREASTFEEDING

16. **What were the main reasons that encouraged you to start breastfeeding?**

____

17. **What or who did you find MOST supportive in helping you to breastfeed your baby?**

____

18. **Do you feel *you got/are getting* adequate breastfeeding support?**

Yes ___ No ____ → **Go to question 19**

↓

From whom? __________________→ Go to question 20

19. **If NO, what else/more support, help or information would you have liked? (Identify problem)**

____

20. **If you were to have difficulties breastfeeding, whom would you get in contact with for advice and support?**

____

→ **Continue to question 29**

Date: **Age of infant 6 weeks + ______days** **Study No.**

FORMULA FEEDING: MOTHERS WHO DIDN'T INITIATE BREASTFEEDING

21. **Why did you choose to bottle-feed?**

____

22. **Were you given information and advice on breastfeeding ante-natally?** Yes ___ No ____

↓ From whom? ________________________

23. **Would you have liked to breastfeed?** **Yes □** **No □**

24. **What were your reasons for not breastfeeding, if you don't mind me asking?**

____

____

____

25. **If you were to breastfeed, how confident do you think you would be?**

Very confident □ Confident□ Poor confidence □ Unsure

Definitely not confident at all □

→ **Continue to question 29**

Date: **Age of infant 6 weeks + ______days** **Study No.**

FOR ALL MOTHERS

27. From whom did you receive most information on infant feeding?

Midwives in hospital……… ☐
Hospital staff……………… ☐
GP………………………… ☐
Antenatal classes………….. ☐
Parentcraft classes………… ☐
Friends…………………….. ☐
Mother…………………….. ☐
Mother-in-law…………….. ☐
Other ____________________
Sister……………………… ☐
Sister in law………………. ☐
Partner…………………….. ☐
Paediatrician……………… ☐
Paediatric Dietitian……….. ☐
Book/television/magazine ____(circle)
Lactation consultant………. ☐
Hospital leaflets/information …. ☐
Internet……………………. ☐

28. Do you give your baby anything other than milk feeds?

- No _____
- Vitamins:

If yes please mention what vitamin and how much is given per day:

____

- Minerals:

If yes please mention what minerals and how much is given per day:

____

- Combination of vitamin/minerals:

If yes please mention what type and how much is given per day:

____

- Herbal, homeopathic remedies/preparations:

____

- Other e.g. Gripe water ___, Lactaide ___, Carabel ___, Infacol ____, Tea ____, Fruit juice_____, Cooled boiled water ____

____

Date: **Age of infant 6 weeks + ______days** **Study No.**

29. **Since the delivery, have you been taking any extra nutritional, vitamin, mineral supplements?** **(Question especially for the breastfeeding mum)**

- No ☐
- If yes, 1.) Please mention what supplements and brand:

  ____

  How much per day/dose?

  ____

  2.) Supplement and brand ______________________________

  How much per day/dose? ______________________________

30. **If you were to have another baby, what method of infant feeding from birth would you choose?**

Breastfeed ☐ Bottle-feed☐ Combination ☐ Not sure ☐

31. **How many times have you seen any of the following health professionals regarding your baby, since you left hospital?**

- Public health nurse……………..….☐ _______
- Paediatrician……………….…….☐ _______
- Local GP………..………………☐ _______
- Midwives from the hospital..…...☐ _______
- Breastfeeding clinic…………….__________

32. **How satisfied were you with you with the delivery and birth experience?**

Very satisfied ☐ Satisfied ☐ Neither satisfied nor dissatisfied ☐

Not satisfied ☐ Not satisfied at all ☐

Date: **Age of infant 6 weeks + ______days** **Study No.**

33. **Since leaving hospital, have you or your baby been on any prescribed medication, or suffered any illness that warranted admission into hospital?**

Mother Yes ☐ No ☐ Describe:

____

Infant Yes ☐ No ☐ Describe:

____

34. **Do you plan on going back to work- outside the home?**

Yes ___ No ___

35. **How long after the birth do you intend on going back to work? (weeks)**

____

36. **Do you think going back to work will affect the way you will feed your baby?**

Yes ___ No ___

↓

In what way, please mention:

____

----

37. **Multi-national/Non-Irish groups**

Would you still feed the baby this method if you were back in your country of origin?

Yes ☐ No ☐

↓

If no, for what reason? ________

____

Date: **Age of infant 6 weeks + ______days** **Study No.**

SECTION B: BIOMEDICAL FACTORS

<u>Question 1.) Type of delivery</u>

a.) Spontaneous vaginal delivery (SVD)……………………………………☐

b.) Caesarean Section…….☐ Elective/Emergency (circle)

Question 2.)

Anaesthetic……Yes ☐………No ☐ General/Spinal/Epidural (circle)

Question 3.)
Baby's Date of Birth (DOB)

____

Question 4.)
Baby's gestational age at birth:

____

Question 5.) Gender of child:
Female☐ Male☐

Question 6.) Small for gestational age……..☐ (3^{rd}- 10^{th} centile)
Appropriate for gestational age.☐ (10^{th}- 50^{th} centile)
Large for gestational age……..☐ (50^{th}- 90^{th} centile)

Question 7.) Mothers latest pre-delivery Hb Level pre-delivery:_________________

Question 8.)

Presence of neonatal jaundice within first four days of life as per <u>diagnostic SBR test:</u>

Yes ☐ No☐

Total Bilirubin Level (if high only) and day taken after birth:

____

Date: **Age of infant 6 weeks + ______days** **Study No.**

Question 9.) Birth and 6-week anthropometric measurements:

Birth weight (g/kg)	**Birth length (cm)**	**Birth head circumference (cm)**
6-week weight **With nappy** □ **Without nappy** □	**6-week length**	**6-week head circumference**

Question 10.) Other measurements reported by the mother:

Measurements taken by the: **GP** □ **Public Health Nurse** □

Infants age:	Weights (g/kg)	Lengths (cm)	Head Circumference (cm)

Date: **Age of infant 6 weeks + ______days** **Study No.**

SECTION C
'Log of infants Feeding History' to date →
To ensure precise feeding history

OPTION 1

Initial Feed/First Feed: Breastfeeding

No. of days/weeks Exclusively Breastfeeding from birth: __________________

No. of days/weeks Predominantly Breastfeeding from birth: ________________

Week when first formula feed was introduced: ___________________

No. of days Partial Breastfeeding from birth: _____________________________

Week when mother fully discontinued breastfeeding: ______________

OPTION 2

Initial Feed/First Feed: Formula Feeding

Day/Week when introduced breastfeeding:_________________________

No. of weeks/days Exclusively Breastfeeding from birth: __________________

No. of weeks/days Predominantly Breastfeeding from birth: ________________

No. of weeks/days Partially Breastfeeding from birth: _____________________

Day/week discontinued breastfeeding: __________________________

OPTION 3:

Initial feeding: Formula and continuation of this method of feeding to six weeks ☐

Date: **Age: 6 Months + ______ days** **Study No:**

Feeding status at 6-week interview:
Exclusively Breastfeeding □ Predominantly Breastfeeding □
Partially Breastfeeding □ Fully Formula Fed □

Infant feeding telephone-interview @ 6-months

*** Infants current feeding status →**

Q.1) 24-hr re-call of infants usual diet:

Time /Frequency	Food/Bottle	Brand/Type of food given	Amount consumed
1	**Formula Name:**	Follow-on □ Casein based □ Whey based □ Specialised milk □ Cow's milk □	**Breastfeeding** **………………..breast feeds/24^0** **Formula/cow's milk** **Total mls/day:** **……..mls X ……..feeds = 24^0**
2			
3			
4			
5			

Q.2) Food Frequency Questions: Summary

1.) How many bottles/daily: ________________________________

2a.) How many solid meals (events)/daily: _______________________ Dessert □

2b.) If meat hasn't been introduced into baby's diet, at what age do you think you will introduce meat? _______________________

3a.) Number of in-between snacks: ___________________________

3b.) Usual type of snacks given: ______________________________

4a) Snack 1………………Frequency per week

4b.) Snack 2………………Frequency per week

4c.) Snack 3……………….Frequency per week

5.) Fluids taken other than milk: ___________________________________

TICK:

- Diluted Baby Juice □……………………..mls/day
- Ordinary Juice □…………………………mls/day
- Water □ …………………………………..mls/day
- Glucose and water □………………………mls/day
- Tea □……………………………………...mls/day
- Coffee □ …………………………………mls/day
- Other ____________________

Q .3) All mums who are feeding their <u>infant formula milk:</u>

a.) Do you add anything else to the bottled formula milk?

Yes □ **No □**

↓

What do you add? ____

b.) For what reason do you add this/these to formula milk?

____

FOR ALL MUMS WHO HAVE INTRODUCED SOLIDS/SPOON FEEDS:

Q.4) a.) If solids/spoon feeds are already introduced, what <u>week</u> was the infant when solids *('anything other than milk')* were first introduced?

____

b.) Why did you decide to introduce first solids/spoon feeds at this time?

____

c.) What introductory solid foods/spoon feeds did you give the infant?

____

d.) How long was the infant on this food before introducing another weaning food?

____

e.) What do you use to mix the weaning foods?

____

f.) What is the main texture/consistency of the foods you give your infant now?

If lumpy consistency, when started on lumps (age in wks)?
↓
____

Pureed ☐ Soft/smooth ☐ Mashed/minced ☐ Soft/lumpy ☐
Roughly chopped☐ Finger food☐

g.) Are most of the weaning foods you give your infant?

1.) Commercial baby foods: Mostly☐ Often☐ Sometimes☐ Never☐

2.) Home-made/home prepared foods using own family foods:

Mostly☐ Often☐ Sometimes☐ Never☐

Q. 5) Do you ever add any of the following to the infants weaning foods?

a.)

Salt	**Yes ____**	**No ____**
Sugar	**Yes ____**	**No ____**
Gravy/Stock based	**Yes ____**	**No ____**
Sauces	**Yes ____**	**No ____**

b.) Are there any foods that you are avoiding? Yes No

What? → ↓ ______________

If so, why?

Allergy ☐ Intolerance ☐ Dietary Preference ☐ Vegetariansim ☐

OTHER REASON: ____

c.) Do you think your baby has an allergy/intolerance? Yes __ No __→ Go to Q6

If YES, to what foods/food groups?

Who diagnosed this allergy/intolerance? (self versus medically)

Are you currently avoiding this/these foods? Yes ___ No ___

Q. 6) Weaning Resources

1.) Where did you get your information on weaning your baby onto solids? ____

____

2.) Did you get professional advice regarding weaning your infant onto solids?

Yes ___ No ___

↓

From Whom?____

3.) Were you happy with the information you received on weaning?

Yes __ No __ → If NO, why not?

____

Q. 7) Child Minding Situation

a.) Does your infant attend a crèche or child minding facility?

Yes ___ No ___

b.) Part-time □

Full-time □

c.) Main Carer: Mother full time Yes □ (tick only)

Q.8) Do you give your baby anything other than milk or solid foods e.g. dietary supplements, drops?

Yes ☐ No ☐

↓

If yes, what do you give, and quantity/day? ________________________________

Q. 9) Does your baby ever drink from a sippie/beaker cup?

Yes ☐ No ☐

↓

What fluid is taken in the beaker cup? _________________

Q.10) Is your baby fed:

On demand/Non-routine (grazing) ☐

On scheduled routine milk and solid feeds ☐

Q.11) Work:

Are you currently working outside the home? Yes ☐ No ☐

⇓

Are you working Part-time ☐ or Full-time ☐

How many weeks after the birth did you return to work? ______________

Q.12) For mums who were breastfeeding at 6-week interview, <u>and have since stopped: WEANING OFF THE BREAST</u>

a.) The week of the baby's last breast feed:

_________________________________→

Total no. of weeks breastfeeding (**any, exclusive, partial or predominant)**

____

b.) What were the reasons for stopping at this time?

____

____

c.) Were you happy to stop breastfeeding at this time?

Yes □ No □

↓ ↓

Why? **If No, why not?** ________________

____

Q. 13) All Breastfeeding Mothers:

Do you feel public facilities in Ireland support/supported your breastfeeding practice?

Agree □ Disagree □ Neither □

Wouldn't breastfeed in public □

Q.14) <u>FOR ALL MUMS WHO ARE STILL BREASTFEEDING</u>

Who or what do you find most supportive in helping you continue breastfeeding?

____

____

Q.15) What are the main reasons for you to continue breastfeeding?

____

____

Q. 16) BABY'S WEIGHT, LENGTH, HEAD CIRCUMFERENCE: Measurements

6-month weight	**6-month length**	**6-month head circumference**
Roslyn ☐ GP ☐ Practice Nurse ☐ Naked ☐ Non-naked ☐		

PUBLICATIONS AND PRESENTATIONS

POSTER PRESENTATIONS

- Breastfeeding prevalence and determinants among a sample of women in Ireland: a country with the lowest breastfeeding rate in Europe. **World Congress of Public Health Nutrition, Barcelona, Spain, September 28-30, 2006.**

- Perceived barriers to the initiation of breastfeeding with view to improving breastfeeding rates in Ireland. **World Congress of Public Health Nutrition, Barcelona, Spain, September 28-30, 2006.**

ORAL PRESENTATIONS

- Inappropriate weaning practices in a sample of healthy 6-month old Irish infants. **Irish Nutrition and Dietetic Institute Research Meeting, Dublin, October 13th 2007.**

- Determinants of early introduction to solid foods in a sample of healthy term infants. **Nutrition Society Research Meeting, University of Ulster, Coleraine, Northern Ireland, June 16-19, 2007.**

- Why mothers stop breastfeeding during the first 6-months of life? **4th World Conference on Developmental Origins of Health and Disease, Utrecht, The Netherlands, September 14-16, 2006.**

- Early infant feeding practices in Ireland. **National Breastfeeding Conference, Dublin, October 6th, 2006.**

PUBLICATIONS

- Tarrant RC (2008) Infant feeding practices in Dublin. *Nutritionwise* **2** (1), 7-9.

- Tarrant RC, Sheridan-Pereira M, Younger KM & Kearney JM (2007) Determinants of early introduction to solid foods in a sample of healthy term infants. *Proc Nutr Soc* **66** (Nov. 4a), Abstract 54a.

- Tarrant RC & Kearney JM (2006) Breastfeeding prevalence and determinants among a sample of women in Ireland: a country with the lowest breastfeeding rate in Europe. *Public Health Nutr* **9** (7a), Abstract EN08-14.

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- Tarrant RC (2005) Solid advice on weaning. *Nursing in the Community*, Nov, 25-26.