



2013-01-01

Mothers Who Formula Feed: Their Practices, Support Needs and Factors Influencing Their Infant Feeding Decision.

Roslyn Tarrant

Dublin Institute of Technology, roslyn.tarrant@gmail.com

Follow this and additional works at: <http://arrow.dit.ie/scschbioart>



Part of the [Dietetics and Clinical Nutrition Commons](#), and the [Public Health Commons](#)

Recommended Citation

Tarrant RC, Sheridan-Pereira M, McCarthy RA, Younger RM & Kearney JM, "Mothers who formula feed: their practices, support needs and factors influencing their infant feeding decision". *Child Care in Practice* 19(1): 78-94. 2013, doi:10.1080/13575279.2012.737764

This Article is brought to you for free and open access by the School of Biological Sciences at ARROW@DIT. It has been accepted for inclusion in Articles by an authorized administrator of ARROW@DIT. For more information, please contact yvonne.desmond@dit.ie, arrow.admin@dit.ie, brian.widdis@dit.ie.



Manuscript title: 'Mothers who formula feed: their practices, support needs and factors influencing their infant feeding decision'

Authors:

- (1) Roslyn C. Tarrant: Clinical Paediatric and Research Dietitian, Department of Clinical Nutrition and Dietetics, Our Lady's Children's Hospital, Crumlin, Dublin 12, Ireland
- (2) Margaret Sheridan-Pereira: Consultant Neonatologist, Department of Paediatrics and Neonatal Medicine, The Coombe Women and Infants University Hospital, Cork Street, Dublin 8, Ireland
- (3) Roberta A. McCarthy: Clinical Specialist Dietitian in Neonatology, Department of Clinical Nutrition and Dietetics, National Maternity Hospital, Holles Street, Dublin 2, Ireland
- (4) Katherine M. Younger: Lecturer in Nutrition and Physiology, Department of Biological Sciences, Dublin Institute of Technology, Kevins Street, Dublin 8, Ireland
- (5) John M. Kearney: Lecturer in Nutrition and Epidemiology, Department of Biological Sciences, Dublin Institute of Technology, Kevins Street, Dublin 8, Ireland

Funding source: Independently and exclusively funded by the Dublin Institute of Technology.

Abbreviated/running title: Maternal formula feeding practices

To cite this article: Tarrant RC, Sheridan-Pereira M, McCarthy RA, Younger KM & Kearney JM (2013). Mothers who formula feed: their practices, support needs and factors influencing their infant feeding decision. *Child Care in Practice*, **19** (1), 78-94.

To link to this article: <http://dx.doi.org/10.1080/13575279.2012.737764>

Abstract

The majority of mothers in Ireland provide formula milk to their infants during the initial weeks postpartum; however, data are lacking on their formula feeding practices and support needs. This prospective Dublin-based observational study, which included 450 eligible mother-term infant pairs recruited and followed up to 6 months postpartum, aimed to advance our understanding of maternal formula feeding practices, their reasons for deciding to formula feed, sources of feeding information and perceived support needs; insights into infant formula milk consumption patterns in relation to current feeding guidelines are also provided. In summary, the vast majority of infants at 6 weeks were provided with formula milk ($n = 368$; 81.8%). Positive maternal perceptions of formula feeding were among the most frequently reported reasons underlying mothers' decision to formula feed (e.g. convenience, 17.3%). Potential public health concerns over the large formula milk volumes consumed by infants (mean 205ml/kilogram/day) relative to infant feeding guidelines (150ml/kilogram/day) were raised from this study. Some mothers continue to add solid foods to infant bottle feeds at 6 weeks (3.8%) and 6 months (6%), a non-recommended feeding practice posing a choking risk for infants. Crucially, this study highlights the need to provide greater support and information to mothers who decide to formula feed postpartum including practical information on sterilisation and formula reconstitution. While breastfeeding promotion and research continues to be a public health priority in Ireland, addressing the support and information needs of mothers who formula feed, an underrepresented and understudied population in the literature, also needs to be considered to ensure optimal health and safety for their infants.

Introduction

To ensure optimal infant and maternal health outcomes, the World Health Organisation (WHO, 2001) recommendation for exclusive breastfeeding for the first six months of life was adopted by the Department of Health and Children in Ireland in 2003. Despite the recognised health (Kramer and Kakuma, 2002; Harder *et al.*, 2005; Quigley *et al.*, 2007) and safety (Renfrew *et al.*, 2003; WHO, 2003) benefits of breastfeeding, many babies worldwide are not breastfed (Organisation for Economic Cooperation and Development, 2009). National and regional data report that 55% (National Perinatal Statistics, 2009) and 66% (Tarrant *et al.*, 2010a) of infants in Ireland, respectively, are partially or exclusively formula fed at maternity hospital discharge; however by 6 months postpartum, almost all infants in Ireland are formula fed in varying quantities (Begley *et al.*, 2009). Whilst several evidence-based objectives and actions to promote, protect and support breastfeeding were set out in the 2005 Five Year Strategic Plan (Department of Health and Children, 2005), Ireland, a country with the highest birth rate in Europe (National Perinatal Statistics, 2009) still reports one of the lowest breastfeeding rates in the developed world, and certainly the lowest in Europe. Similarly low breastfeeding rates are reported in the UK where, at 6 weeks postpartum, approximately 79% of infants are either exclusively or partially formula fed (Bolling *et al.*, 2007).

Breastfeeding is the recommended standard for infant feeding, however, in circumstances where mothers choose to formula feed postpartum, are unable to breastfeed, or when breastfeeding is contraindicated, the provision of care and formula feeding education to these mothers should be 'of the highest standard possible' (Wirihana and Barnard, 2012) if risk

is to be averted. Powdered infant formula (PIF) is not a sterile food product and several recent expert guidelines have been developed to minimise contamination risks during preparation, handling and storing of the product (Food Safety Authority of Ireland, 2007; WHO, 2007). Optimising compliance with such public health guidelines is essential given the reported deleterious effects of bacterial contamination of PIF with *Enterobacter sakazakii* on infant outcomes including life-threatening neonatal meningitis, bacteraemia and necrotising enterocolitis (Forsythe, 2005; Drudy *et al.*, 2006).

In addition, errors in under or overconcentration of feeds can potentially lead to serious morbidities for infants including, dyselectrolytemia, hypernatremic dehydration, obesity and failure to thrive (Chambers and Steel, 1975; Sunderland and Emery, 1979). The correct use and choice of formula are considered to be equally important (Egemen *et al.*, 2002). Given the diverse age and condition-specific formulations and market brands available, there is also potential for parents to be misinformed and confused about recommended age-specific appropriate formula. To protect infants and optimise their outcomes, it is thus essential that clear, correct information on formula feeding (Osborn and Lyons, 2010) and reconstitution is provided to parents in all circumstances.

Associations between early infant feeding method and long term health outcomes *via* a potential early 'programming' mechanism are well established (Stanner and Smith, 2005; Rudnicka *et al.*, 2007). According to recent research, higher protein intakes in infant formula per kilogram (kg) of body weight, in excess of metabolic requirements, have been hypothesised to enhance weight gain in infancy and potentially contribute to increased risks for later obesity (Koletzko *et al.*, 2009). Despite such accumulating evidence, a paucity of information is available

in the literature on infant formula milk consumption patterns. In light of increasing evidence demonstrating the importance of early life nutrition on optimal growth and development for short and long term infant health, it is crucial to gain an understanding of current formula feeding patterns.

In view of the above, this study aimed to examine mothers' formula feeding practices, their reasons for formula feeding and sources of feeding information as well as infant formula milk consumption patterns at 6 weeks. A further objective was to assess maternal satisfaction with the adequacy of formula feeding information in a sub-sample of mothers.

Methods

Participants and study design

Study methods and sample representativeness of this prospective observational study have been previously described in detail (Tarrant *et al.*, 2010a). In brief, an initial sample of 539 low-risk pregnant women (≥ 24 weeks gestational age) was recruited between June 2004-October 2006 from antenatal clinics in the Coombe Women and Infants University Hospital (CWIUH) in Southwest Dublin. The study consisted of two core study groups: Study Group 1 (recruited and followed-up during June 2004-September 2005) and Study Group 2 (recruited and followed-up during October 2005-October 2006). There was no difference in study methodology or treatment of any mother-infant pair in Study Groups 1 and 2 with the exception of one added final question in the 6 week questionnaire pertaining to formula feeding support needs for mothers in Study Group 2 (refer to Methods Section: '*Assessment of mothers' satisfaction with*

formula feeding information during the first 6 weeks); mothers in both groups were questioned by the one investigator.

From the 491 women who gave written informed consent to participate (91%), 450 (83%) met the study inclusion criteria: delivery of a healthy, term (≥ 37 weeks gestational age), singleton infant, weighing ≥ 2.5 kg at birth, maternal willingness to participate in study follow-up and reporting residency in Ireland to 6 months postpartum. All 450 mother-infant pairs were followed up by the one investigator, a trained paediatric dietitian, either by face-to-face or telephone interview at 6 weeks and 6 months postpartum.

Data collection

Antenatal (≥ 24 weeks gestational age)

The first patient-administered questionnaire completed by pregnant women in the antenatal clinic waiting rooms collected data on socio-demographic factors (age, educational attainment level and marital status), smoking habits and their infant feeding intention.

6 week follow-up

Infant anthropometric measurements

All eligible mothers were contacted to arrange a 6 week hospital clinic appointment where a face-to-face interviewer-administered questionnaire was conducted, and the infants' naked weight measurements taken. Naked weights were measured using a high specification portable electronic calibrated Seca 835-2 Class (III) according to EC Directive 90/384/EEC baby scales (Seca, Birmingham, UK) with a weight capacity of 50kg and a graduation of 20g. Of three consecutive weight measurements, an average weight was taken. Mothers who were unable to

attend the hospital clinic appointment were interviewed by telephone and the reported weight measurements from the routine 6 week check-up with the general practitioner (GP)/paediatrician or public health nurse (PHN) visit (i.e. a role similar to that of a 'health visitor') were recorded.

Infant feeding data

The 6 week questionnaire elicited detailed data on the infants' feeding history from birth; it was also noted whether solid foods (e.g. infant cereal/crushed rusk biscuits) were added to infant bottle feeds. Mothers were questioned on their main sources of infant feeding information (multiple response options). There was also a specific enquiry for the mothers who formula fed from birth as to why they chose this feeding method (open-ended question; responses were then categorised).

Formula feeding practices and patterns

Mothers who were formula feeding at the 6 week follow-up were questioned on the specific type and brand of formula used, the responses to which were then categorised as: standard whey-predominant, standard casein-predominant and a group of non-standard infant formulas including partially-hydrolysed, pre-thickened, lactose-free, extensively hydrolysed, organic, goats milk-based, soy-based as well as follow-on infant formula specific to the > 6 month age group. Data on the frequency of formula type/brand changes during the first 6 weeks were obtained and further categorised as: no formula type/brand changes, 1, 2 and ≥ 3 changes, and where relevant, mothers' reasons for each specific change documented (open-ended question; responses were then categorised). Among the group of mothers who were fully formula

feeding at 6 weeks, information pertaining to the infant's feeding frequency and estimated formula milk volume consumed per 24 hours was recorded. In cases where the infants' 6 week weight measurements were available, the volume of formula milk consumed per kg/body weight/day was computed.

Assessment of mothers' satisfaction with formula feeding information during the first 6 weeks

Comments made by mothers in Study Group 1 regarding the lack of available formula feeding support and information prompted an additional and final question in the 6 week questionnaire for the mothers in Study Group 2 who were fully formula feeding their infants. This additional question assessed mothers' satisfaction with the formula feeding information received during the first 6 weeks and if unsatisfied, what specific information and support they would have valued (open-ended question; responses were then categorised).

6 month follow-up

The 6 month follow-up involved an interviewer-administered questionnaire with mothers either by telephone, or face-to-face interview in their own home. Data pertaining to the infants' weaning diet at 6 months were collected, including an enquiry about maternal additions of solid foods to infants' bottle feeds (Tarrant *et al.*, 2010b).

Explanatory measures

Infant feeding definitions and categories

Breastfeeding practices were classified according to the WHO definitions (WHO, 1991; WHO, 1996). Other infant feeding categories in the present study included: (1) mothers who formula

fed from birth, (2) those who initiated breastfeeding and fully switched to infant formula milk during the first 6 weeks (i.e. 'the switchers') and (3) the 'partial breastfeeders', who provided their infants with breast milk in combination with supplementary formula milk feeds during the first 6 weeks. Mothers who were 'fully formula feeding' at 6 weeks includes those who formula fed from birth, as well as those who switched from breastfeeding to full formula feeds during the first 6 weeks.

Statistical analysis

Analyses were performed using the Statistical Package for the Social Sciences[®] Version 19.0 (SPSS[®] Inc., Chicago, IL, USA). Data were summarised using numerical descriptive statistics including means with standard deviations ([SD], minimum-maximum [min-max] values), number of observations or percentages, or medians with interquartile ranges (IQR), as appropriate. Normality of data was checked using the Kolmogorov-Smirnov test and QQ plots. Relationships between categorical variables were examined using cross tabulations and χ^2 statistics test; the Yates continuity correction value was used for all 2 x 2 tables. For continuous normally distributed data, the Student's *t*-test or one-way analysis of variance (ANOVA) were performed. Significance levels were defined as $P < 0.05$.

Results

Sample characteristics

From the 450 eligible mothers, 138 (30.7%) attended the hospital for a face-to-face interview and 312 (69.3%) were followed up by telephone interview at 6 weeks postpartum. In total, 368 (81.8%) provided their infants with formula milk at 6 weeks; the remaining mothers were either

exclusively ($n = 78$; 17.3%) or predominantly ($n = 4$; 0.9%) breastfeeding. The formula feeding group of mothers ($n = 368$) included those who formula fed from birth ($n = 222$; 60.3%), 'the switchers' from breast to formula milk ($n = 97$; 26.4%) and the partial breastfeeders ($n = 49$; 13.3%). Mothers who formula fed from birth were significantly more likely to have been: single (15.8%), younger (mean 27.7 years), smokers (35.1%), less educated and to have antenatally reported an intention to formula feed (81.1%); these mothers were also more likely to have reported adding solid foods to their infants' bottle feeds at 6 weeks (5.4%; $P < 0.05$) (Table 1).

Reasons for mothers' decision to formula feed from birth ($n = 222$)

The convenience of formula feeding was the most frequently reported reason underlying mothers' decision to formula feed from birth (17.3%) (Table 2). Other principal reasons related to their pre-pregnancy feeding decision (15.7%) and feeling more comfortable with formula feeding in public (15.7%). Few mothers reported the perception that formula fed infants 'sleep through the night' and are 'more satisfied babies' as reasons for formula feeding from birth (1.3%).

Sources of infant feeding information during the first 6 weeks ($n = 368$)

Table 3 details mothers' infant feeding information sources during the first 6 weeks. Public health sources of information including hospital leaflets and antenatal classes were more frequently reported by the partial breastfeeders (10.7% and 9.1%, respectively) compared with the formula feeders from birth (6.9% and 3.8%, respectively) and 'the switchers' from breast to formula feeding (4.9% and 2.5%, respectively). An overall trend towards increased use of non-

professional infant feeding information sources was observed among the formula feeders from birth (72.3%) in comparison with those who partially breastfed (58.6%).

Formula feeding practices at 6 weeks postpartum (n = 368)

Just over half of the mothers who formula fed at 6 weeks provided their infants with a standard whey-predominant infant formula ($n = 197$; 53.6%); a casein-predominant formula was provided to over one third of the sample ($n = 139$; 37.8%) (data not shown). Non-standard formulas including partially hydrolysed ($n = 20$; 5.4%), pre-thickened ($n = 4$; 1.1%), lactose-free ($n = 2$; 0.5%), extensively hydrolysed ($n = 1$; 0.3%), organic ($n = 2$; 0.5%), goat's milk-based ($n = 1$; 0.3%) and soy formulas ($n = 1$; 0.3%) were consumed by fewer infants. One infant (0.3%) was reported to consume a follow-on formula specific to the > 6 month age group (data not shown).

Almost half of the mothers who formula fed their infants at 6 weeks ($n = 181/368$, 49.2%) reported to changing their infants formula type/brand at least once during the first 6 weeks [1 formula type/brand change, $n = 162$ (44%); 2 changes, $n = 14$ (3.8%); ≥ 3 changes, $n = 5$ (1.4%)]. Table 4 indicates that 54.8% of these mothers perceived increased infant hunger/feeding frequency as the main reason for changing their type/brand of infant formula; 'infant not sleeping through the night' was reported as a reason for brand/type change in 4.6% of the sample.

Feeding patterns of the infants who were fully formula fed at 6 weeks (n = 319)

Data on formula feed frequency/24 hours, along with reported formula volumes consumed/24 hours were available only for the fully formula fed infants at 6 weeks ($n = 319$). The mean no. of formula feeds, and the total feed volume consumed per 24 hours by these infants was 6.2 feeds

(SD 0.94 feeds, min-max 4-12 feeds) and 988ml (SD 204ml, min-max 210-1,920ml), respectively. The 6 week infant weight measurements were available for 184 of the sample ($n = 101$ taken by the investigator RCT; $n = 63$, GP/paediatrician; $n = 20$, PHN) with a mean of 205ml (SD 45ml, min-max 129-364ml) of formula milk/kg body weight/day consumed by these infants. Based on the protein content of the specific infant formula milk type/brand consumed, this formula milk volume (205ml/kg/day) was equivalent to a mean protein consumption of 3.1 grams of protein/kg body weight/day (SD = 0.8 grams, minimum-maximum = 1.8-6.2 grams).

Assessment of mothers' satisfaction with formula feeding information (n = 141)

Mothers in Study Group 2 ($n = 208$) included 93 mothers who formula fed from birth along with 48 mothers who switched from breast to formula milk during the first 6 weeks; thus 141/208 (68%) mothers in Study Group 2 were fully formula feeding their infants at the 6 week follow-up. Of these, 24.8% ($n = 35$) reported dissatisfaction with the formula feeding information received during the first 6 weeks. Over one third of the sample (36.7%) reported a need for detailed information specific to formula types/brands including indications for changing from whey to casein-predominant formula feeds (Table 5). The need for practical information on sterilising bottles/teats, and a demonstration on formula reconstitution prior to hospital discharge, was indicated by 21% of mothers.

Discussion

Findings from the present study substantially add to our understanding of formula feeding practices among mothers in Ireland as well as the reasons underlying their decision to formula feed. Consistent with previous research (Twomey *et al.*, 2000; Sloan *et al.*, 2006; Cairney and

Barbour, 2007), lower socio-economic status factors were strongly associated with formula feeding from birth. While such factors were undoubtedly associated with mothers' decision to formula feed, and their formula feeding practices, equally evident from this study was the important influence of mothers' infant feeding attitudes and perceptions. The finding that 81.1% of mothers who formula fed from birth antenatally reported an intention to formula feed suggests that their feeding decision was determined well before the birth, and perhaps even pre-pregnancy. Maternal infant feeding attitudes (Scott *et al.*, 2004) and antenatal feeding intention (Donath *et al.*, 2003) have been reported as stronger predictors of feeding choice than standard socio-demographic variables. Taken together, these data support the need for targeted antenatal breastfeeding interventions aimed at pregnant women who express an intention to formula feed; such research should consider optimal approaches to altering maternal feeding intention with a view to increasing breastfeeding rates.

In agreement with the literature (McIntyre *et al.*, 1999, Brown *et al.*, 2011), we found that positive perceptions of formula feeding were among the most frequently reported reasons underlying mothers' decision to formula feed including the method being perceived as 'convenient' and 'routine' (17.3%) and affords greater freedom to the mother (9.7%). The finding that 15.7% of these mothers perceived formula feeding as being a 'more comfortable' and less embarrassing way to feed an infant is not at all surprising given the numerous Irish studies that have identified 'maternal embarrassment' about breastfeeding and the practice being 'unappealing' to the mother, as reasons for not initiating breastfeeding, or choosing to formula feed (Loh *et al.*, 1997, Sloan *et al.*, 2006, Begley *et al.*, 2009). Incompatible social norms have been reported to make it difficult for mothers to successfully breastfeed in Ireland

(Stewart-Knox *et al.*, 2003). While the cultural barrier towards breastfeeding still clearly prevails, overriding the strong influence of positive formula feeding beliefs and perceptions in women even prior to conception appears one of the greatest challenges for Irish breastfeeding promotion campaigns.

This study provides several insights into current formula feeding practices which have potential implications for infant health and public health policy. Maternal efforts to establish what they perceived to be a more desirable feeding pattern (e.g. by promoting fixed feeding schedules, prolonged sleep and longer durations between feeds) was a dominant theme identified in our research. For instance, during the initial weeks postpartum, current guidelines recommend use of a whey-predominant formula since it contains a casein:whey protein ratio similar to mature breast milk (40:60) (Kunz and Lönnerdal, 1992); however, such a formula type was consumed by only 53.6% of the infants in our study. A casein-predominant formula, which is a second-stage formula type containing a comparatively higher casein:whey ratio (80:20) and marketed for 'hungrier babies' was consumed by over one third of infants (37.8%) at the early stage of 6 weeks. It is also of interest that maternal additions of solid foods to infant bottle feeds at 6 weeks (5.4%) and 6 months (7.7%) was a practice particularly reported by those who formula fed from birth. Such a non-recommended practice in the early weeks postpartum is not only associated with a desire to 'promote infant sleep', and 'decrease infant hunger' (Wright *et al.*, 2004; Tarrant *et al.*, 2010b) but also poses a potential choking risk for infants (Health Canada 2007, p. 9), as well as increasing percentage body fat and weight in childhood (Wilson *et al.*, 1998). Furthermore, a trend towards a high frequency of formula type/brand changing was evident among the study participants (49.2%) with the main reasons for such changes

including 'increased infant hunger/feeding frequency' (54.8%) as well as 'the infant was not sleeping through the night' (4.6%). It could be argued that mother-led reasons may underlie their intentional efforts to increase infant satiety at the early stage of 6 weeks, and achieve regular 4 hourly feeding. The fact that mothers' main reason for deciding to formula feed from birth related to the method being convenient/routine, further supports this suggestion.

While efforts to promote infant sleep and establish routine feeding were evident among many of the formula feeders in this study, it has been pointed out that young infants are not expected to sleep through the night (Sears, 1999, p. 13). Fomon *et al.* (1979) in an earlier review of infant feeding did not accept that long periods between feeds are advantageous to infants. Moreover, it is known that infants experience growth spurts between the first one to two weeks, at six weeks and again at 12 weeks postpartum (La Leche League 2004, p. 98). Such periods are characterised by increased infant appetite, requiring greater milk volumes at an increased 'on-demand' feeding frequency. In lieu of increasing the infants' feeding frequency and volumes of a whey-predominant formula, mothers' response to increased infant hunger during these times may have led them to change their infants' formula type/brand to a casein-predominant feed, or add solid foods to their infants' bottle feeds. The degree to which insufficient infant feeding information contributed to such practices merits further exploration. To address some potential maternal misperceptions about infancy feeding patterns, formula feeding literature and advice should emphasise the fact that frequent feeding in the early weeks postpartum is the normal physiological requirement for infants (Food Safety Authority of Ireland, 1999).

The fully formula fed infants at 6 weeks for whom weight measurements were available ($n = 184$) consumed a mean formula intake of 205ml/kg/day in this study, with a maximum reported consumption of 364ml/kg/day being observed. Relative to infant feeding guidelines which advise a fluid intake of 150ml/kg/day during the first 6 months (Nutritional Requirements for Children in Health and Disease 2009, p. 9) it appears that many infants in the present study consumed a considerably greater than recommended formula volume per kg/day. Given emerging evidence demonstrating the impact of rapid weight gain during infancy on increased risks for later obesity (Baird *et al.*, 2005) in addition to associations between higher protein in infant formula and higher growth in the first 2 years of life (Koletzko *et al.*, 2009) our data may have implications for the later obesity risk of some infants in our sample. Against a backdrop of increasing global childhood obesity levels, as well as an increasing prevalence of toddler overweight (Nader *et al.*, 2006) the diet during infancy presents a potentially ideal window of opportunity for obesity prevention (Gillman, 2002). Accordingly, to ensure dietary energy balance and relative proportionate growth in infancy, literature and health professional advice to formula feeding parents should consider the inclusion of more individualised and detailed guidance on recommended infant formula milk volumes. This may be of further public health importance given recent evidence indicating a higher risk of later obesity and Type 2 diabetes in children who were formula fed during infancy (Stuebe, 2009).

Use of 'non-professional' infant feeding information sources was identified in almost two thirds of the mothers who formula fed from birth in this study (72.3%), with 'family' being the most frequently reported information source (39%); other investigators have reported similar findings (Cairney and Barbour, 2007). The fact that only 15.8% of these mothers

reported a 'health professional' as an infant feeding information source raises questions as to whether professional infant feeding guidance was actually received during the first 6 weeks. It is also possible that professional advice was received however, traditional inter-generational advice 'handed-down' from family members was more influential on mothers' feeding practices (Daly *et al.*, 1998). It is noteworthy that such familial advice is at risk of being out-dated, having the potential to misinform mothers. Since all mothers during the first week post maternity hospital discharge have at least one direct contact with their PHN, optimising their positive impact on parental formula feeding practices is a potential area for public health intervention. For future infant feeding studies, it would be worthwhile to include, and make clear distinctions between the sources of infant feeding information 'received' by mothers versus the 'valued' infant feeding information sources that actually influence maternal feeding practices.

Substantial deficiencies in formula feeding information were highlighted by almost one quarter (24.8%) of a sub-sample of mothers (Study Group 2, $n = 35/141$), including details which are regarded as pertinent to the safety and health of infants. Of particular concern, 21% of mothers' expressed a need for practical information on sterilisation of bottles/teats as well as formula reconstitution. The Baby-Friendly Hospital Initiative is associated with a system that provides optimal support to mothers who breastfeed (Merewood *et al.*, 2005), however, there does not appear to be an equivalent level of support for mothers who formula feed. According to the WHO (2003), infants who are not breastfed, for whatever reason, should receive special attention from the health system since they constitute a 'risk group'. Based on our findings, there is a clear need for improved practical support, as well as the provision of professional infant feeding information to mothers who formula feed postpartum.

Limitations of this study include the recruitment of mothers from a single site maternity hospital in Southwest Dublin, thus limiting the generalisation of the data to the rest of Ireland. We assessed maternal satisfaction with formula feeding information among a sub-sample of 141 mothers in Study Group 2, the responses to which may not have been representative of the total sample. Face-to-face versus telephone interviews with mothers may have influenced their responses in some instances. Given that the 6 week questionnaire relied on maternal self-reports of retrospective events we cannot determine the impact of memory or response bias on our results. Strengths of the study include data completeness and successful follow-up of all mother-infant pairs at the 6 week and 6 month time points which enabled comparability between infant feeding groups. Collection of the 6 week feeding status for all infants in addition to the 6 week weight measurements in a sub-sample of infants led to a relatively accurate measurement of infant formula milk consumption patterns at 6 weeks. Furthermore, this is one of the very few Irish infant feeding studies performed by the one investigator, a paediatric dietitian, which has prospectively examined maternal formula feeding practices, over a 2 year period.

Conclusions

Results from this study inform health professionals and public health policy of much needed data specific to mothers who decide to formula feed postpartum. Potential concerns over certain formula feeding practices were raised from this study including reported additions of solid foods to infant bottle feeds as well as the large formula milk volumes consumed by infants (mean 205ml/kg/day) relative to infant feeding guidelines (150ml/kg/day), findings which may

have implications for their later obesity risk. Major deficits in formula feeding information were highlighted in almost one quarter of a sub-sample of fully formula feeding mothers, suggesting that a lack of professional infant feeding guidance may have been associated with suboptimal formula feeding practices. Given the impact that incorrect preparation of formula feeds can have on infant health, our data highlight a need to provide more support and practical information to parents who formula feed, particularly in regard to formula reconstitution and sterilisation of bottles/teats. While breastfeeding promotion and research continues to be a public health priority in Ireland, it is important that consideration is also given to the appropriate provision of parental guidance on formula feeding to ensure optimal health and safety for the large number of babies that are not breastfed.

Acknowledgements

The authors thank all the participating mothers for their commitment to this study. They are also extremely grateful to the clinical and administrative staff at the Coombe Women and Infants University Hospital for their practical help and support, and to Ms. Ita Saul for her help with manuscript revision. Finally, a special thanks to the Dublin Institute of Technology for funding for this study.

References

- Baird, J., Fisher, D., Lucas, P., Kleijnen, J., Roberts, H., and Law, C. (2005). Being big or growing fast: systematic review of size and growth in infancy and later obesity. *British Medical Journal*, 331: 929-935.

Begley, C., Gallagher, L., Clarke, M., Carroll, M., and Millar, S. (2009). *The National Infant Feeding Survey 2008*. Dublin: The Health Service Executive.

Bolling, K., Grant, C., Hamlyn, B., and Thornton, A. (2007). *A Survey Conducted on Behalf of the Information Centre for Health and Social Care and the UK Health Departments by BMRB Social Research*. London: Office of National Statistics, The Information centre.

Brown, A., Raynor, P., and Lee, M. (2011). Health care professionals' and mothers' perceptions of factors that influence decisions to breastfeed or formula feed infants: a comparative study. *Journal of Advanced Nursing*, 67: 1993-2003.

Cairney, P. and Barbour, R., (2007). A research study of sources of support for bottle feeding new mothers. *Community Practitioner*, 80: 30-34.

Chambers, T.L., and Steel, A.E., (1975). Concentrated milk feeds and their relation to hypernatraemic dehydration in infants. *Archives of Disease in Childhood*, 50: 610-615.

Daly, A., MacDonald, A., and Booth, I.W. (1998). Diet and disadvantage: observations on infant feeding from an inner city. *Journal of Human Nutrition and Dietetics* 11, 381-390.

Department of Health and Children, (2005). *Breastfeeding in Ireland: A Five-Year Strategic Action Plan*. Dublin: Department of Health and Children.

Donath, S.M., Amir, L.H. and the ALSPAC Study Team (2003). Relationship between prenatal infant feeding intention and initiation and duration of breastfeeding: a cohort study. *Acta Paediatrica*, 92: 352-356.

Drudy, D., Mullane, N.R., Quinn, T., Wall, P.G., and Fanning, S. (2006). *Enterobacter sakazakii*: an emerging pathogen in powdered infant formula. *Clinical Infectious Diseases*, 42: 996-1002.

Egemen, A., Kusin, N., Aksit, S., Emek, M., and Kurugol, Z. (2002). A generally neglected threat in infant nutrition: incorrect preparation of infant formulae. *The Turkish Journal of Pediatrics*, 44: 298-303.

Fomon, S.J., Filer, L.J. Jr., Anderson, T.A., and Ziegler, E.E. (1979). Recommendations for feeding normal infants. *Pediatrics*, 63: 52-59.

Food Safety Authority of Ireland, (1999). *Recommendations for a National Infant Feeding Policy*. Dublin: FSAI.

Food Safety Authority of Ireland, (2007). *Information Relevant to the Development of Guidance Material for the Safe Feeding of Reconstituted Powdered Infant Formula: Guidance Note No. 22*. Dublin: FSAI.

Forsythe, S.J., (2005). Enterobacter sakazakii and other bacteria in powdered infant milk formula. *Maternal and Child Nutrition*, 1: 44-50.

Gillman, M., (2002). Breast-feeding and obesity. *The Journal of Pediatrics*, 141: 749-750.

Harder, T., Bergmann, R., Kallischnigg, G., and Plagemann, A. (2005). Duration of breastfeeding and risk of overweight: a meta-analysis. *American Journal of Epidemiology*, 162: 397-403.

Health Canada, (2007). *Feeding Your Baby from 6-12 Months* [online]. Available from: http://www.health.gov.nl.ca/health/publications/feedingyourbaby6_12months.pdf [Accessed 3rd October 2012].

Koletzko, B., von Kries, R., Closa, R., Escribano, J., Scaglioni, S., Giovannini, M., et al. (2009). Lower protein in infant formula is associated with lower weight up to age 2 y: a randomized clinical trial. *The American Journal of Clinical Nutrition*, 89: 1836-1845.

Kramer, M.S. and Kakuma, R., (2002). *The Optimal Duration of Exclusive Breastfeeding: a Systematic Review*. Geneva, World Health Organisation: Department of Child and Adolescent Health and Development.

Kunz, C. and Lönnerdal, B., (1992). Re-evaluation of the whey protein/casein ratio of human milk. *Acta Paediatrica*, 81: 107-112.

La Leche League., (2004). *The Womanly Art of Breastfeeding*. 7th revised ed. London: Penguin Books Ltd.

Loh, N.R., Kelleher, C.C., Long, S., and Loftus, B.G. (1997). Can we increase breastfeeding rates? *Irish Medical Journal*, 90: 100-101.

McIntyre, E., Hiller, J.E., and Turnbull, D. (1999). Determinants of infant feeding practices in a low socio-economic area: identifying environmental barriers to breastfeeding. *Australia and New Zealand Journal of Public Health*, 23: 207-209.

Merewood, A., Mehta, S.D., Chamberlain, L.B., Philipp, B.L. and Bauchner, H. (2005). Breastfeeding rates in US baby friendly hospitals. *Pediatrics*, 116: 628-634.

Nader, P.R., O'Brien, M., Houts, R., Bradley, R., Belsky, J., Crosnoe, R., *et al.*, (2006). Identifying risk for obesity in early childhood. *Pediatrics*, 118: e594-601.

National Perinatal Statistics, (2009). *Report on the National Perinatal Statistics 2009*. Dublin: Economic, Social and Research Institute and Department of Health and Children.

Nutritional requirements for children in health and disease, (2009). *Nutritional requirements for children in health and disease*, 4th ed. London: The Nutrition and Dietetic Department, Great Ormond Street Hospital for Children NHS Trust.

Organisation for Economic Cooperation and Development, (2009). *OECD Family Database*. Paris: OECD Social Policy Division, Directorate of Employment, Labour and Social Affairs: OECD. <http://www.oecd.org/els/familiesandchildren/43136964.pdf> [Accessed October 17th 2012].

Osborn, K. and Lyons, M., (2010). Is bottled water really unsafe for making up infant formula? *Community Practitioner*, 83: 31-34.

Quigley, M.A., Kelly, Y.J., and Sacker, A. (2007). Breastfeeding and hospitalization for diarrheal and respiratory infection in the United Kingdom Millennium Cohort Study. *Pediatrics*, 119: e837-842.

Renfrew, M.J., Ansell, P., and Macleod, K.L. (2003). Formula feed preparation: helping to reduce the risks; a systematic review. *Archives of Disease in Childhood*, 88: 855-858.

Rudnicka, A.R., Owen, C.G., and Strachan, D.P. (2007). The effect of breastfeeding on cardiorespiratory risk factors in adult life. *Pediatrics*, 119: e1107-1115.

Scott, J.A., Shaker, I., and Reid, M. (2004). Parental attitudes toward breastfeeding: their association with feeding outcome at hospital discharge. *Birth*, 31: 125-131.

Sears, W., (1999). *Nighttime parenting: how to get your baby and child to sleep*, revised ed. Schaumburg, Illinois, USA: La Leche League International.

Sloan, S., Sneddon, H., Steward, M., and Iwaniec, D. (2006). Breast is best? Reasons why mothers decide to breastfeed or bottle feed their babies and factors influencing the duration of breastfeeding. *Child Care in Practice*, 12: 283-297.

Stanner, S. and Smith, E., (2005). Breastfeeding: early influences on later health. *Nutrition Bulletin*, 30: 94-102.

Stewart-Knox, B., Gardiner, K., and Wright, M. (2003). What is the problem with breastfeeding? A qualitative analysis of infant feeding perceptions. *Journal of Human Nutrition and Dietetics*, 16: 265-273.

Stuebe, A., (2009). The risks of not breastfeeding for mothers and infants. *Reviews in Obstetrics and Gynecology*, 2: 222-231.

Sunderland, R. and Emery, J.L., (1979). Apparent disappearance of hypernatraemic dehydration from infant deaths in Sheffield. *British Medical Journal*, 2: 575-576.

Tarrant, R.C., Younger, K.M., Sheridan-Pereira, M., White, M.J., and Kearney, J.M. (2010a). The prevalence and determinants of breast-feeding initiation and duration in a sample of women in Ireland. *Public Health Nutrition*, 13: 760-770.

Tarrant, R.C., Younger, K.M., Sheridan-Pereira, M., White, M.J., and Kearney, J.M. (2010b). Factors associated with weaning practices in term infants: a prospective observational study in Ireland. *British Journal of Nutrition*, 104: 1544-1554.

Twomey, A., Kiberd, B., Matthews, T. & O'Regan, M. (2000). Feeding infants: an investment in the future. *Irish Medical Journal*, 93: 248-250.

Wilson, A.C., Forsyth, J.S., Greene, S.A. Irvine, L., Hau, C., & Howie, P.W. (1998). Relation of infant diet to childhood health: seven year follow up of cohort of children in Dundee infant feeding study. *British Medical Journal*, 316: 21–25.

Wirihana, L.A. and Barnard, A., (2012). Women's perceptions of their healthcare experience when they choose not to breastfeed. *Women and Birth*, 25: 135-141.

World Health Organisation, (1991). *Indicators for Assessing Breastfeeding Practices, Division of Child Health and Development (WHO/CDD/SER/91)*. Geneva: WHO.

World Health Organisation, (1996). *Global Data Bank on Breastfeeding (WHO/NUT/96.1)*.

Geneva: WHO.

World Health Organisation, (2001). *Fifty-Fourth World Health Assembly. Global Strategy for Infant and Young child feeding: the Optimal Duration of Exclusive Breastfeeding*. Geneva: WHO.

World Health Organisation, (2003). *Global Strategy for Infant and Young Child Feeding*. Geneva: WHO.

World Health Organisation, (2007). *Safe Preparation, Storage and Handling of Powdered Infant Formula. World Health Organisation in collaboration with Food and Agriculture of the United Nations*. Geneva: WHO.

Wright, C.M., Parkinson, K.N., and Drewett, R.F. (2004). Why are babies weaned early? Data from a prospective population based cohort study. *Archives of Disease in Childhood*, 89: 813-816.

Table 1. Selected characteristics of the sample, stratified according to infant feeding category.^a

Characteristic	Formula feeders from birth <i>n</i> = 222	Switchers to full formula feeding during the first 6 wks <i>n</i> = 97	Partial breastfeeders at 6 wks <i>n</i> = 49	Total sample <i>N</i> = 368
Maternal age, mean (SD), years*	27.7 (SD 5.9)	29.5 (SD 5.2)	31.9 (SD 4.9)	28.7 (SD 5.8)
Maternal education level, <i>n</i> (%)*				
Primary/secondary	122 (55)	33 (34)	9 (18.4)	164 (44.6)
Vocational/training course	60 (27)	34 (35.1)	13 (26.5)	107 (29.1)
Third level degree/postgraduate level	40 (18)	30 (30.9)	27 (55.1)	97 (26.4)
Marital status, <i>n</i> (%)**				
Married/cohabitating	187 (84.2)	92 (94.8)	47 (95.9)	326 (88.6)
Single	35 (15.8)	5 (5.2)	2 (4.1)	42 (11.4)
Smoked during pregnancy, <i>n</i> (%)*	78 (35.1)	9 (9.3)	2 (4.1)	89 (24.2)
Parity, <i>n</i> (%)**				
Primiparous	85 (38.3)	58 (59.8)	26 (53.1)	169 (45.9)
Multiparous	137 (61.7)	39 (40.2)	23 (46.9)	199 (54.1)
Infant gender, <i>n</i> (%)				
Male	116 (52.3)	62 (63.9)	22 (44.9)	200 (54.3)
Female	106 (47.7)	35 (36.1)	27 (55.1)	168 (45.7)
Antenatal infant feeding intention, <i>n</i> (%)*				
Breastfeed	10 (4.5)	68 (70.1)	37 (75.5)	115 (31.3)
Formula feed	180 (81.1)	3 (3.1)	N/A	183 (49.7)
Combined breastfeeding and formula feeding	7 (3.2)	21 (21.6)	10 (20.4)	38 (10.3)
Unsure	25 (11.3)	5 (5.2)	2 (4.1)	32 (8.7)
Gestational age at birth, mean (SD), wks	40.1 (SD 1.3)	40.3 (SD 1.2)	40 (SD 1.1)	40.1 (SD 1.3)
Infant birth weight, mean (SD), kg**	3.4 (SD 0.5)	3.6 (SD 0.4)	3.6 (SD 0.5)	3.5 (SD 0.5)
Infant weight at 6 weeks, mean (SD), kg ^b	4.8 (SD 0.62)	5 (SD 0.66)	5 (SD 0.62)	4.9 (SD 0.63)
No. public health nurse visits during the first 6 wks, <i>n</i> (%)**				
1-2	120 (54.1)	47 (48.5)	17 (34.7)	184 (50)
> 2	102 (45.9)	50 (51.5)	32 (65.3)	184 (50)
Maternal additions of solid foods ^c to infants' bottle feeds at 6 weeks, <i>n</i> (%)***				
Yes	12 (5.4)	2 (2.1)	N/A	14 (3.8)
Maternal additions of solid foods ^c to infants' bottle feeds at 6 months, <i>n</i> (%)				
Yes	17 (7.7)	3 (3.1)	2 (4.1)	22 (6)

Data are expressed as mean (SD) or *n* (%). kg, kilogram; N/A, not applicable. * *P* < 0.0001; ** *P* < 0.01; *** *P* < 0.05.

a Median timing of 6 week and 6 month follow-up for all mother-infant pairs (*n* = 368): 6.57 weeks (IQR: 6.1- 7 weeks) and 24.7 weeks (IQR: 24.4-25 weeks), respectively.

b Total no. measurements (*n* = 212): formula feeders (*n* = 127), switchers (*n* = 57) and partial breastfeeders (*n*=28).

c Includes additions of baby rice/crushed rusk biscuits/infant cereals.

Table 2. Reasons for mothers' decision to formula feed from birth.

Reasons	n	%
Convenience of formula feeding: easy, quick, routine feeding method ('non-demand')	107	17.3
Pre-pregnancy decision was to formula feed	97	15.7
A more comfortable way to feed a baby; not embarrassing in public/in front of others	97	15.7
Family tradition to formula feed/formula fed previous children	73	12
Partner involvement and 'bonding is possible with formula feeding'	61	10
'More freedom', 'everyone can mind the baby'; 'not tied to the baby'	60	9.7
Negative perception of breastfeeding ^a	55	9
Medical reason ^b	19	3
Reassuring to quantify the volume of formula milk consumed by the infant	16	2.6
No confidence in ability to breastfeed	11	1.7
Events post birth made breastfeeding difficult e.g. post C-Section/long recovery time	11	1.7
Formula fed infants 'sleep through the night' and are 'more satisfied babies'	8	1.3
Total number of responses ^c	615	99.7

a Includes 'breastfed infants are never content', breastfeeding is associated with 'stress', 'tiredness' and 'physical difficulties e.g. mastitis/latching issues'.

b Includes maternal illness e.g. Hepatitis C and/or maternal medication/drug use e.g. methadone/anti-depressants which were reported to contraindicate breastfeeding.

c Mothers could report more than one reason for their decision to formula feed from birth.

Table 3. Mothers' reported sources of infant feeding information during the first 6 weeks.

Reported sources	Formula feeders from birth (n = 222) n (%)	Switchers to full formula feeding (n = 97) n (%)	Partial breastfeeding (n = 49) n (%)
Family ^a	197 (39)	77 (31.4)	27 (22.3)
Health professionals ^b	80 (15.8)	37 (15.2)	23 (19)
Media/TV/advertising/magazines/internet/DVD	55 (10.8)	46 (18.9)	20 (16.5)
Experience with previous children	55 (10.8)	23 (9.4)	7 (5.8)
Hospital leaflets	35 (6.9)	12 (4.9)	13 (10.7)
Friends	30 (5.9)	24 (9.8)	15 (12.4)
Commercial information ^c	22 (4.4)	13 (5.3)	2 (1.6)
Antenatal classes	19 (3.8)	6 (2.5)	11 (9.1)
Childcare course/training from college	7 (1.4)	1 (0.4)	3 (2.5)
Common sense/intuition	7 (1.4)	5 (2)	-
Total number of responses ^d	507	244	121
Based on the above sources, further categorisations to:			
Professional/public health information sources	141 (27.9)	56 (23)	50 (41.3)
Non-professional information sources	366 (72.3)	188 (76.8)	71 (58.6)

a Includes partner, mother, mother-in-law, sister, sister/s-in law, grandmother, aunt and cousin.

b Includes public health nurse, paediatrician, hospital midwives and general practitioner.

c Includes postal information on infant feeding, commercial telephone care lines and gift packs posted to home.

d Mothers could report more than one source of infant feeding information.

Table 4. Mothers' reported reasons for changing the infant's formula type/brand during the first 6 weeks.

Reported reasons	<i>n</i>	%
Increased hunger/feeding frequency (2-3 hourly)	108	54.8
Poor tolerance of formula feed due to diarrhoea/vomiting	31	15.7
Infant was unsettled on the formula feed e.g. windy/colicky and seemed lactose intolerant	27	13.7
Infant was constipated on the formula feed	15	7.6
Infant was not sleeping through the night	9	4.6
Friends advised a heavier feed such as casein-based to 'fill the infant up'	3	1.5
Infant was medically diagnosed cow's milk protein allergy, so had to change to a hypoallergenic formula feed	3	1.5
Informed by a friend that the infant was on an inappropriate feed type	1	0.5
Total number of responses ^a	197 ^b	99.9

**Based on the above responses,
further categorisations to:**

Perceived issues with feeding pattern (increased hunger, infant not sleeping through the night, friends advised a heavier feed)	120	60.9
Perceived issues with feed tolerance (due to diarrhoea/vomiting, constipation, unsettled on feed [windy/colicky])	73	37
Medical advice (infant was medically diagnosed with an allergy)	3	1.5
Non-professional advice (informed by a friend to change the feed type)	1	0.5

a Mothers could report more than one reason for changing their infant's formula type/brand.

b Note: number of responses includes 197 of the 206 total feed type/brand change occasions; the remaining 9 responses were due to increased hunger (in cases where mothers reported > 1 formula type/brand change this variable overlapped).

Table 5. Information and support needs of the mothers whom reported dissatisfaction with the formula feeding information received.

Specific formula feeding information and support requested	n	%
Detailed information on formula types/brands available: Differences between feed types, indications for changing from whey to casein-predominant formula feeds, recommended feeds and indications for each e.g. best for colic, constipation	42	36.7
Practical information needed on: How to sterilise a bottle/teat and make up a feed, a demonstration on formula reconstitution should be given prior to hospital discharge. What are the best teats to use/teat differences?	24	21
Information specific to the feeding process: Recommended formula volumes/feed and guidance on preventing under/overfeeding. 'What is a normal feeding pattern for a healthy baby?' Is on-demand/routine feeding best?	21	18.5
More health professional input and guidance on formula feeding	11	9.6
More attention should be given to first time mothers	6	5.3
Guidance for mothers who partially breastfeed: Practical information is required on how to co-ordinate breastfeeding with supplementary formula feeds	6	5.3
Information on the timing of growth spurts to alert mothers to the fact that feed frequency and volume will increase around these times	2	1.8
More consistency in the advice provided by health professionals e.g. on whether an infant should be fed 'on demand', or whether they should be woken up for feeds	2	1.8
Total number of responses ^a	114	100

^a Mothers could report more than one response.