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Formula supplementation remains a risk for cow's milk allergy in breast-fed infants

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Key words Cows milk allergy, infant feeding, policy, breastfeeding

Abstract

Background

Many breast fed babies in Ireland receive formula supplementation within 24 hours of birth. We explored (i) impact of formula supplementation on the likelihood of developing Cow's Milk Protein Allergy (CMPA), and (ii) current practice of formula supplementation (<24h) among mothers intending to breast feed.

Method:

55 CMPA-diagnosed children, fed at <24h of age (breast only, formula only or breast with formula supplementation) were recruited and 55 milk-tolerant age- and sex-matched controls were identified retrospectively in Cork University Maternity Hospital. Two Logistic regressions (LoR) examined neonatal feed types on likelihood of developing CMPA while controlling for parental atopy and infant sex. Formula supplementation was then prospectively measured among a separate group of 179 breast-feeding mothers. Linear regression (LiR) analysis was used to examine; the subjective and objective reasons for formula supplementation, in addition to examining pre-existing factors.

Results:

Two LoR examined the infant groups: exclusively breast fed, exclusively formula fed or breast fed with formula supplementation. The first LoR model, showed only formula supplementation was significant in prediction of development of CMPA, (χ^2 (3) = 25.74, $p < 0.05$) with 74% diagnostic accuracy when parental atopy and infant sex were controlled for. Breast-fed infants given formula supplements were 7.03 (95% CI, 1.82 - 27.25) times more likely to exhibit CMPA than those who were exclusively breast-fed. Formula supplementation was significant (OR 16.62, 95%CI. 3.89 –

71.11), indicating that breast-fed infants who were given formula supplements were 16 times more likely to exhibit CMPA than those who were exclusively bottle-fed. Exclusively formula-fed infants (Odds Ratio 0.42, 95% C.I., 0.16 – 1.07) were not significantly more likely to exhibit CMPA than those who were exclusively breast-fed in either model ($p > 0.05$).

45.8% breast-fed infants (<24h) received supplemental formula. LiR investigated importance of the subjective and objective reasons, in predicting formula supplementation. This model was significant $F(8,170)=66.95$, $p < 0.05$) explaining 75% total variance. The subjective factors 'no latch' and 'Mum unwell' were the strongest predictors ($\beta > 0.45$). Objective factors and pre-existing factors had lower β values with only mode of delivery and infant hypoglycaemia being significant.

Conclusion:

Breast fed babies are still being put at significantly increased risk of CMPA by receiving supplemental formula in the 1st 24 hours of life, despite the major predictors of supplementation being subjective and remediable in other ways. Mothers and health care providers should be better educated on the benefits of exclusive breast feeding and resourced adequately to avoid unnecessary formula supplementation to reduce risk of development of CMPA.

Introduction

Exclusively breast-feeding infants, for at least the first four to six months, is recommended by the Nutrition committees of the American Association of Paediatrics and European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), irrespective of atopic heredity. The immune-modulatory function of breast milk is thought to lead to significant short and long term effects for the healthy trajectory of a child's development(1).

The risk for a breastfed baby to develop Cows Milk Protein Allergy (CMPA) is influenced by its immunologic development, and by the timing and volume of exposure to infant formula (2, 3, 4). The prevalence of CMPA in Ireland (1% at 2 years) appears similar to other developed countries (5). In other series the prevalence rate increases to one-in-five for 'high-risk' infants (e.g. due to atopic heredity) who are fed Cows Milk Formula (CMF) during the first year of life (6).

Infrequent exposure to CMF, with a high antigen level, of a baby receiving human milk may interfere with the normal development of tolerance to ingested cow's milk (7, 8, 9, 10). Ratner discussed measures to prevent and treat CMA nearly 80 years ago including 'avoiding isolated feedings of raw cow's milk to the breast fed infant during the new-born period' (11). A meta-analysis of studies from 1979 to 2012 (12) reported a risk ratio of 1.75 for breastfed infants given cow's milk formula

supplementation in the first few weeks of life against no supplementation given to breastfed infants.

Ireland has one of the lowest breastfeeding rates in the developed world and the lowest rate in Europe (13). Only 55% of women leaving Irish maternity hospitals following birth were breastfeeding their child at all, and only 47% exclusively (14). International evidence suggests breastfeeding initiation may be influenced by the institutional environment experienced by the mother (15). Most Irish maternity hospitals are not adequately adhering to national Breastfeeding Policy guidelines (13).

The first aim of this study was to explore retrospectively the impact of CMF supplementation on the likelihood of developing CMPA. The second aim was to prospectively assess the current practice of formula supplementation (<24h) among mothers intending to breast feed and explore the reasons and factors around supplementation of breast-feeds with formula in a hospital setting. The prospective study is important to include as it provides an insight into the typical frequency of formula supplementation and for what reasons. This is of particular importance because this information was not available from the retrospective review only.

Method

Participants:

For the retrospective arm of this study, we used purposive sampling to identify all infants born in one calendar year, who had been formally diagnosed with CMPA in Cork University Maternity Hospital (CUMH, 9,000 deliveries per annum). 55 CMPA infants in total were identified. All cases of CMPA were identified from referral to allergy clinic from primary care. They were all reviewed by experienced staff and received all allergy care from a single, experienced paediatric allergist

(JO'BH) using allergy focussed clinical history, SPT, SpIgE measurement and open food challenge, if necessary. The control group consisted of 55 cows milk tolerant infants, retrospectively case-matched to the CMPA cases for age and sex from the CUMH birth register. Each control participant was the nearest same sex infant in the register to the index case, born on the same day.

For the prospective arm of this study, random sampling was used using ward lists on the postnatal wards in CUMH to identify participants. Mothers in CUMH were randomly chosen according to their stated intention to breast-feed and whether they had given birth more than 24 hours previously. In total 179 breast-feeding mothers were included. Ethical approval was granted by the Clinical Research Ethics Committee of the Cork Teaching Hospitals. An information letter was sent to each parent informing them of the purpose of the research study and what the interview would entail should they choose to participate. Consent was obtained prior to each telephone interview. During the interview, parents were asked if their child had CMPA and the type of feed given on the first day of life.

Study Design:

It was hypothesised that the rate of CMF supplementation of breast-fed infants would be higher in the CMPA cases than in control infants (CMP tolerant), when parental atopy and sex were controlled for.

The study was observational in nature. Both components involved chart review and conducting phone interviews to obtain additional information.

The retrospective case control study aimed to examine the impact of formula supplementation within the first 24 hours of life on the likelihood of developing CMPA. There were three predictor variables: initial type of feed, sex of infant and parental atopy. There were three different initial type of feeding patterns: breast-fed exclusively, CMF exclusively, and breast-fed with CMF supplementation.

Details of the type of feed received within the first 24 hours of life by the cohort group were verified by review of the patient's medical records in which the initial type of feed had been documented. A telephone interview was conducted with the parents of the children in the control group using a template which had received ethical approval.

The prospective study added to the retrospective study, by assessing current rate of formula supplementation and what factors influenced this supplementation. We recorded at what point formula supplementation had occurred, given by whom, where, and the reported reason for its administration. Additional data was collected through chart review which included maternal age, parity, type of delivery, the mother's pre-delivery stated intention to breast- or bottle-feed, previous experience of breast-feeding and gestation.

Data Analysis:

All data was collated in EXCEL and exported to SPSS v.22 (IBM Evanston Illinois, USA) for analysis. For all data, preliminary checks and descriptive statistics were run to ensure the data was suitable for parametric testing. Assumption-testing specific to each test was carried out to ensure the appropriate statistical analyses were used. Statistical significance was defined as a P value of 0.05 or less.

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Independent T-tests were used to ensure that the case-control data were adequately matched. A Kruskal-Wallis test was used to determine if there were differences between feed types for CMP-allergic group on age of onset. A logistic regression was used to investigate the influence of formula supplementation, within 24 hours of life on the likelihood, of developing CMPA, while controlling for potential influencing variables, including infant sex and parental atopy.

Unconditional logistic regression was used to control variables that are related to, or may influence, the dependent variable (CMPA). This was used as matching in a case-control study does not control for confounding by the matching factors. This matched design required controlling for the matching factors in the analysis (16). A “standard” (unconditional) analysis is the most valid and appropriate, and a “matched” (conditional) analysis may not be required or appropriate (16). For the prospective survey two linear regressions were conducted. Firstly, reasons given for supplementation were examined to identify the strongest significant predictor(s) of formula supplementation. Secondly, the pre-existing factors noted in the chart review were also examined to determine their influence on the likelihood of developing CMPA.

Results

Profile of participants in Retrospective Study

55 CMPA diagnosed infants, (born 2010-2011) showed an even distribution according to sex of child (Female 47.3%). 43.6% of this sample was breast-fed exclusively. Overall the use of CMF formula was slightly higher (56.4%) in this sample than that reported in the prospective Factors survey (45.8%), however this difference was not statistically significant ($p=0.17$).

The control group consisted of 55 non CMPA infants, born between the years 2010 and 2011. 53.7% of this CMP- tolerant sample were male and 42% were breast-fed exclusively ($p > 0.05$). The control group was case-matched accurately to the CMPA cases, with no significant differences in terms of sex of infant ($p > 0.05$), or whether they were exclusively breast-fed or received formula between the two groups ($p > 0.05$), according to Independent T-tests used.

As possible predictors of CMPA, parental atopy and sex of infant, were controlled for in the logistic regression. The logistic regression model was statistically significant, $\chi^2(3) = 25.74$, $p < 0.0005$. Hosmer and Lemeshow Goodness of Fit Test was not significant $X^2(6, N=110) = 5.5$, $p = 0.48$, indicating the model's reliability. It has an overall percentage accuracy in classification of 74%. Sensitivity, was 70% for prediction of CMPA, and specificity was 78% for correct rejection of CMPA. Positive predictive value (PPV) was 0.76 for CMPA, with negative predictive value (NPV) of 0.71.

A logistical regression was run using three predictor variables - sex, parental atopy and initial type of feeding method were assessed for risk of developing CMPA (Table 2), with breast feed exclusively as the reference group. Only initial feed type was significant ($p < 0.001$). Breast-feeding with formula supplementation was the only neonatal feed type to contribute significantly ($p = 0.005$) to the predictive model, with an odds ratio of 7.01(95%C.I., 1.79 – 27.01), indicating that breast-fed infants who were given top-up formula were 7 times more likely to exhibit CMPA than those who were exclusively breast-fed (Table 2). Exclusive formula feeding did not contribute significantly ($p = 0.07$) to the predictive model with an odds ratio of 0.42 (95%C.I., 0.16 – 1.07). This indicates that infants who were bottle-fed exclusively were not more likely to exhibit CMPA than those who were exclusively breast-fed, controlling for all other variables in the model (Table 2).

To ensure the results were not due to order effects, the logistical regression analysis was re-run with exclusively formula feed as the reference group. This model was also statistically significant, $\chi^2(3) = 25.10$, $p < 0.000$. Hosmer and Lemeshow Goodness of Fit Test was not significant $X^2(6, N=110) =$

5.5, $p=0.48$, indicating the model's reliability. It has an overall percentage accuracy in classification of 73.4%. Sensitivity, was 69.1% for prediction of CMPA, and specificity was 78% for correct rejection of CMPA. Positive predictive value (PPV) was 0.76 for CMPA, with negative predictive value (NPV) of 0.71.

Again, only initial feed type was significant ($p < 0.001$). Breast-feeding with formula supplementation was the only neonatal feeding pattern to contribute significantly ($p = 0.000$) to the predictive model, with an odds ratio of 16.62(95% C.I., 3.89 – 71.11), indicating that breast feeding infants who were given top-up CMF were 16 times more likely to exhibit CMPA than those who were exclusively bottle-fed. Breast feeding exclusively did not contribute significantly ($p=0.07$) to the predictive model and this indicates that infants who were breast-fed exclusively were not significantly more likely to exhibit CMPA than those who were exclusively bottle-fed.

Prospective Factors survey

The prospective sample was variable in terms of maternal age, number of births, birth weight and gestation (Table 3). In this sample of 179 breast-feeding mothers, the MF supplementation rate within 24 hours of life was 45.8%. Formula supplementation (Table 4) was most frequently given to the infant in the same room as the mother (73.2%), consistent with CUMH's policy of "rooming-in". It is important to note that 43.9% of formula supplementation was administered by Health Care Personnel.

The majority of reasons given for supplementation were attributable to infant-related factors, which can be seen in Figure 1. A Linear Regression was used to investigate the importance of reasons given (Figure 1) in predicting formula supplementation. The reasons were split into two groups – subjective factors (which could be considered relatively easily modifiable) and objective factors (considered relatively less easily modifiable). *Low birth weight* and *infant hypoglycaemia* were the only objective factors of eight reasons given.

Reasons for CMF supplementation explained 75% of total variance of the feeding type ($R^2_{\text{Adjusted}}=.748$, $F(8,170)=66.947$, $p<0.05$). Only low birth weight did not significantly predict formula supplementation ($\beta= 0.04$, $t(178) = 1.08$, $p=0.28$), all other variables were significant. Subjective/ modifiable subjective factors rather than objective factors are the strongest predictors of formula supplementation with 'no latch' ($\beta=0.53$, $p\leq 0.05$) and 'mum unwell/exhausted' ($\beta=0.45$, $p\leq 0.05$) being the strongest predictors, showing large beta values (Table 5).

Pre-existing factors were also investigated. The factors *parity*, *maternal age*, *birth weight*, *gestation*, *previous experience of breast-feeding*, *intention to breast- or bottle-feed*, and *type of delivery* were assessed. 91% had stated an intention to breast-feed (91.1%) with 43% having breast-fed previously. 6.6% were undecided regarding feed type; 2.3% had decided on formula supplementation). A linear regression model found these 'pre-existing' factors only explained 7% of the total variance in whether a mother breast exclusively.

The retrospective showed that formula supplementation (parentally reported) has an impact on CMPA risk. The prospective study demonstrated the typical frequency of formula supplementation and for what reasons, highlighting that formula supplementation often occurs due to subjective modifiable reasons.

Discussion

A mothers' decision regarding how to feed her baby is influenced by many psychological and social factors, and is strongly influenced by advice and support from HCPs (17). The aim of this study was to explore the currently common Irish practice of formula supplementation (<24h) by mothers intending to breast feed, the impact of this supplementation on the likelihood of developing Cow's Milk Protein Allergy (CMPA), and the reasons and factors underlying this practice which is persisting in Ireland despite its adverse immunological effects being identified and rectified in Denmark 30

years ago (2) and intensive cultural and political pressure to improve and sustain breastfeeding rates in Ireland.

The relationship between early exposure to cow's milk (CM) protein and the subsequent development of CMA has been illustrated in previous studies (7, 8). In one prospective study, it was found that those infants who had been exclusively breast fed from birth and who subsequently developed CMA had been exposed to CM formula in the first three days of life (7). A second prospective study demonstrated that exposure to CM while in hospital also increased the risk of CMA (8). Host et al also showed that CMA did not develop in any of 210 infants exclusively breast fed in hospital (7), highlighting the protective effect of breastfeeding. The potential for CM proteins to prime allergic sensitization underlies the hypothesis that early, short term exposure to these may initiate the development of CMA (9, 10). Subsequent or continued exposure to CM proteins may promote tolerance (8). We were unable to explore this in secondary analysis as we did not collect data on duration of supplementation. Irish data, from our centre, show a very steep decline in breastfeeding after discharge from hospital to the lowest rate in the EU by 3m.

This study shows that when infant sex and parental atopy are controlled for, CMP formula supplementation of breast feeding infants within the first 24 hours of life is strongly associated with developing CMPA (OR: 7.0), and that exclusively formula fed infants had no increased risk of CMPA compared to exclusively breast fed infants who were not offered supplements. These models are robust as they were accurately able to classify the majority of participants with high levels of sensitivity and specificity.

This study's report of breast feeding infants with CMPA has the limitation of being a retrospective case control study, so it can only document association not causality but its findings reflect those made in population based studies and it adds important analysis regarding the reasons for such supplementation, most of which appear to be remediable factors relating to post-natal ward culture

and custom. Further research and education are needed to reduce the modifiable and subjective factors that increase formula supplementation.

Although the study findings are significant for a strong relationship between early exposure to CM protein while breastfeeding and CMA, an acknowledged limitation of the study is the possibility of recall bias. Parents were interviewed one to two years following the birth of their children and the exact type of formula supplementation given on the first day of life may have been difficult to recall with accuracy. However, hydrolysed formulae are not available in our post natal wards, so any formula offered would have been “normal, age- appropriate” formula. A questionnaire which had received ethical approval was used to minimise the risk of interviewer bias.

The impact of CMPF supplementation over both exclusive breast feeding and exclusive formula feeding is notable. However, there may be bias in this finding as families who consider themselves low risk for having CMPA children may choose to formula feed and conversely high risk families are often advised or may choose to breast feed exclusively. Nonetheless CMP supplementation of breast-fed infants dramatically confounds the parental plan to breast feed to prevent allergic conditions. Another identifiable potential limitation is that the CMPA cases were identified retrospectively as they presented to our paediatric allergy service and controls were matched retrospectively, but the matching appeared to be good when formally tested.

Formula supplementation was most frequently given to the infant in the same room as the mother (73.2%), rather than the nursery, possibly reflecting the rooming in policy in place in our hospital. Yet, 43.9% of formula supplementation was administered by HCPs, not parents, a higher rate than that reported recently in the UK (18). We found that subjective reasons explained a very high proportion (75%) of total variance in our models with ‘no latch’ and ‘mum unwell/exhausted’ emerging as the strongest predictors for formula supplementation in contrast to objective factors such as low baby weight. This distinction is important since subjective factors can be modified more easily than objective factors. Our findings concur with previous research about promotion of breast feeding,

although the novel aspect of this study is that these factors were examined in the context of the likelihood of CMPA.

It is also notable that the breastfeeding mothers surveyed had all previously given birth to at least one child. Research has shown that health professionals often focus their attention, support and guidance on first time mothers, although the reasons reported for supplementation in our study apply to all groups, regardless of parity (19, 20).

Our study focused on exposure to CM proteins within the first 24 hours of life to assess the impact of this brief exposure to cows milk protein in infants who go on to breast feed on development of subsequent CMPA. It remains to be determined if continued supplementation of formula in breast feeding infants would promote or prevent sensitisation through development of tolerance to the preferred antigen (21).

Maternal subjective factors and perhaps even more importantly health care professionals' practices appear to be very significant but potentially modifiable drivers of formula supplementation of breast fed infants, which appears to be an immunologically detrimental practice that should be avoided.

References

1. Le Huërrou-Luron, I., Blat, S., & Boudry, G. Breast-v. formula-feeding: impacts on the digestive tract and immediate and long-term health effects. *Nutrition Research Reviews* 2010;23(01), 23-36.
2. Høst, A., Halken, S., Muraro, A., Dreborg, S., Niggemann, B., Aalberse, R., ... & Zeiger, R. S. Dietary prevention of allergic diseases in infants and small children. *Pediatric Allergy and Immunology*, 2008; 19(1): 1-4.
3. Saarinen, K. M., & Savilahti, E. Infant feeding patterns affect the subsequent immunological features in cow's milk allergy. *Clinical and Experimental Allergy* 2000;30(3): 400-406.

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4. Sánchez-Valverde, F., Gil, F., Martinez, D., Fernandez, B., Aznal, E., Oscoz, M., & Olivera, J. E.. The impact of caesarean delivery and type of feeding on cow's milk allergy in infants and subsequent development of allergic march in childhood. *Allergy* 2009; 64(6): 884-889.
 5. Kelleher M, Dunn-Galvin A, Gray C, Murray D, Kiely M, Kenny L, McLean WHI, Irvine AD Hourihane JO'B. Skin barrier impairment at birth predicts food allergy at two years of age. *J Allergy Clin Immunol* 2016; doi.org/10.1016/j.jaci.2015.12.1312
 6. Høst, A. Cow's milk protein allergy and intolerance in infancy. Some clinical, epidemiological and immunological aspects. *Pediatric Allergy and Immunology*, 1994;5(S6):, 5-36.
 7. Host A, Husby S, Osterballe O. A prospective study of cow's milk allergy in exclusively breast-fed infants. Incidence, pathogenetic role of early inadvertent exposure to cow's milk formula, and characterization of bovine milk protein in human milk. *Acta Paediatr Scand* 1988;77(5):663-70.
 8. Saarinen, K.M.; Juntunen-Backman, K.; Järvenpää, A-L.; Kultunen, P.; Lope, L.; Renlund, M.; Silvola, M. and Savilahti, E. Supplementary feeding in maternity hospitals and the risk of cow's milk allergy: A prospective study of 6209 infants. *J. Allergy Clin. Immunol.* 1999;104, 457-461.
 9. Host A. Importance of the first meal on the development of cow's milk allergy and intolerance. *Allergy Proc.*1991;12(4):227-32.
 10. Saarinen KM, Juntunen-Backman K, Jarvenpaa AL, Klemetti P, Kuitunen P, Lope L, Renlund M, Siivola M, Vaarala O, Savilahti E. Breast-feeding and the development of cows' milk protein allergy. *Adv Exp Med Biol* 2000;. 478:121-30.
 11. Ratner, B. The treatment of milk allergy and its basic principles. *JAMA* 1935;105(12): 934-939.
 12. Smith, H. A. Formula supplementation and the risk of cow's milk allergy. *British Journal of Midwifery* 2012; 20(5): 345-350.

- Accepted Article
13. Department of Children and Youth Affairs. *Growing Up in Ireland: Maternal Health Behaviours and Child Growth in Infancy*. Dublin: Department of Child and Youth Affairs 2015.
 14. Health Information and Research Division ESRI. *Perinatal Statistics Report 2011*. Dublin: Economic and Social Research Institute.
 15. Bartington, S., Griffiths, L.J., Tate, A.R. & Dezateux, C. Are breastfeeding rates higher among mothers delivering in Baby Friendly accredited maternity units in the UK? *International Journal of Epidemiology* 2006; 35(1):1178-1186.
 16. Pearce, N. Analysis of matched case-control studies. 2016 *BMJ*; 352: i969
 17. Radzyminski, S.; Callister, L.C. Mother's beliefs, attitudes, and decision making related to infant feeding choices. *J. Perinat. Educ.* 2016; 25:18–28.
 18. Biggs KV, Hurrell K, Matthews E, Khaleva E, Munblit D, Boyle RJ
Formula Milk Supplementation on the Postnatal Ward: A Cross-Sectional Analytical Study. *Nutrients* 2018;10(5): 608; <https://doi.org/10.3390/nu10050608>.
 19. Nguyen, T.; Dennison, B.A.; Fan, W.; Xu, C.; Birkhead, G.S. Variation in Formula Supplementation of Breastfed Newborn Infants in New York Hospitals. *Pediatrics* 2017;140: E20170142.
 20. Hunter, L.; Magill-Cuerden, J.; McCourt, C. 'Oh no, no, no, we haven't got time to be doing that': Challenges encountered introducing a breast-feeding support intervention on a postnatal ward. *Midwifery* 2015;31: 798–804.
 21. Perkin M.R, Logan K., Tseng A. et al. Randomized Trial of Introduction of Allergenic Foods in Breast-Fed Infants. *N Engl J Med* 2016;374:1733-43. DOI: 10.1056/NEJMoa1514210.

Table 1: Feed type in first 24 hours of life for the Participants in the Retrospective Study (N=110).

	Exclusively breast fed in 1st 24 hr of life Number (%)	Mixed breast & formula feeding in 1st 24 hour of life Number (%)	Exclusively formula fed in first 24 hrs of life Number (%)	Total in each participant type Number (%)
Participant Type				
Cases (with CMPA)	24 (43.6%)	16 (29.1%)	15 (27.3%)	55 (100%)
Controls (case- matched)	23 (41.8%)	9 (16.4%)	23 (41.8%)	55 (100%)
Total	47	25	38	110

Table 2. Predictive Model for Case-control study

	B	S.E.	Wald	P value	Odds Ratio	95% Confidence Intervals	
						Lower	Upper
Parental atopy (control)	0.61	0.44	1.92	0.16	1.85	0.78	4.37
Infant Sex (control)	0.22	0.44	0.25	0.62	1.25	0.52	2.99
Initial Feed Type			14.41	0.001			
Bottle-Fed Exclusive*	-0.87	0.48	3.28	0.07	0.42	0.16	1.07
Formula Supplementation*	1.94	0.69	7.89	0.005	7.01	1.79	27.01

**These were compared to Breast-fed exclusively in the model*

Table 3

Demographics of mothers surveyed prospectively re breastfeeding practices and preferences

	Mean	Std. Deviation	Variance
Maternal Age (years)	32.05	4.91	24.10
Parity	1.99	1.21	1.47
Birthweights (grams)	3563.80	457.22	2948.41
Gestation (weeks)	39.68	1.38	1.89

Table 4. Location and Provider of Formula Supplementation

Formula Supplementation: **n (%)**

By whom:

HCP* 36 (43.9)

Mother 46 (56.1)

Location:

Room with Mother 60 (73.2)

Nursery 22 (26.8)

*Health Care Professional

Table 5. Linear Regression of predictors of Formula Supplementation.

	b	SE B	β	p
(Constant)	10.146	0.55		0.00
	(9.06, 11.23)			
Advised by nurse**	0.66	0.14	0.20	0.00
	(0.93,0.39)			
Breast soreness**	0.61	0.12	0.20	0.00
	(0.84,0.38)			
No latch**	0.78	0.06	0.53	0.00
	(0.89,0.67)			
Baby very tired/not settling/irritable**	0.62	0.07	0.32	0.00
	(0.76,0.48)			
Low blood glucose*	0.69	0.09	0.29	0.00
	(0.89,0.51)			
Baby very small*	0.21	0.19	0.04	0.28
	(0.59,0.17)			
Mum unwell/exhausted**	0.77	0.07	0.45	0.00
	(0.89,0.64)			
Infant still hungry**	0.67	0.07	0.39	0.00
	(0.80,0.54)			

95% confidence intervals reported in parentheses * Objective Factor ** Subjective Factor

Figure 1. Incidence of Factors underlying Formula Supplementation

