

ORIGINAL COMMUNICATION

Infant feeding patterns in the Finnish type I diabetes prediction and prevention nutrition study cohort

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Objective: To investigate infant feeding patterns during the first 2 y and their relation to sociodemographic factors.

Design: A population-based cohort study.

Setting: Oulu and Tampere University Hospital district areas 1996–1999, Finland.

Subjects and methods: All newborn infants ($n = 675$) with increased genetic risk for type I diabetes were invited to the study in 1996–1997. Of these, 429 (64%) completed the dietary follow-up form by the time they reached 2 y of age.

Results: The median duration of exclusive breastfeeding (BF) was 1.8 months (range 0–6 months) and that of total BF 7.0 months (0.3–25 months). Among the infants 20% were exclusively breastfed at least 4 months (recommendation 4–6 months). Infants were introduced to infant formula at the median age of 1.8 months (range 0–25 months) and other supplementary foods at the median age of 3.5 months (1–6 months). Infant's ponderal index at birth was inversely associated with the duration of total BF. The age of introduction of supplementary foods correlated positively with the duration of total BF. Longer parental education and increased maternal age were associated with a longer duration of BF and older age at introduction of supplementary foods. Infant formula and other supplementary foods were added earlier to the diet of the boys than that of the girls.

Conclusion: Duration of breastfeeding in Finland is shorter than recommended. Compliance with the current recommendations on the timing of introduction of first supplementary food and dairy products is relatively poor. The diet during infancy seems to be conspicuously influenced by the duration of parental education, maternal age and the sex of the infant.

European Journal of Clinical Nutrition (2005) 59, 107–113. doi:10.1038/sj.ejcn.1602045

Published online 8 September 2004

Keywords: breastfeeding; infant formula; supplementary food; sociodemographic factors

Introduction

Infants experience many dietary changes during their first year of life; starting in most cases exclusively with breast

milk they gradually go through the transition from a completely liquid diet to one including a variety of solid foods. Exclusive breast feeding is recommended worldwide for infants during the first 4–6 months (Statement of the Standing Committee on Nutrition, 1994; American Academy of Pediatrics, 1997; Hasunen *et al*, 1997; Position of the American Dietetic Association, 1997; WHO, 2003) based on scientific evidence of health benefits in breastfed infants, and advantages for the mothers, the health system and society (ESPGAN Committee on Nutrition, 1982; Forsyth, 1995; Heinig & Dewey, 1996; Heinig & Dewey, 1997; Lutter, 2000; Yngve & Sjöström, 2001a). Breastfeeding should preferably continue beyond the first year of life, and it is not recommended that infants should be given supplementary foods before the age of 4 months. Insufficient prenatal breastfeeding education, short postpartum hospital

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Contributors: SMV has designed the nutrition study in DIPP and is responsible for the study. MK participated in the protocol development. PV-A worked as a study coordinator and was responsible for the quality of questionnaires together with EH. H-MP coded the dietary follow-up forms. ME and H-MP were responsible for dietary assessment and data analysis and drafting the manuscript. All the coauthors participated in the evaluation of results and writing the manuscript. Received 27 January 2004; revised 7 June 2004; accepted 29 June 2004; published online 8 September 2004

stay, limit of professional support, maternal employment, lack of broad societal support, and powerful marketing of infant formulas are among the barriers to breastfeeding (American Academy of Pediatrics, 1997; Position of the American Dietetic Association, 1997). A short duration of breastfeeding and introduction of supplementary foods at an early age can be associated with development of allergies (Chandra, 2002), obesity (Wilson *et al*, 1998), and chronic diseases, such as celiac disease (Ivarsson *et al*, 2002), cardiovascular diseases (Fall *et al*, 1992) and type I diabetes (Virtanen & Knip, 2003). In industrialised countries, young and less well-educated mothers are less likely to breast feed than other mothers (Michaelsen, 1997; Riva *et al*, 1999; Scott *et al*, 1999). Small family size has been shown to have a positive impact on breastfeeding (Yngve & Sjöström, 2001b) and male infants are more likely to be weaned earlier than female peers (Pande *et al*, 1997; Scott, 1999; Scott *et al*, 1999).

In comparison with other European countries the rate and duration of breastfeeding in Finland have been quite high (Yngve & Sjöström, 2001a). Results from a national survey performed in 2000 (Hasunen, 2002) indicated that 68% of infants younger than 1 month were exclusively breast fed, but the target of breastfeeding exclusively up to the age 4–6 months was rarely achieved. The study also demonstrated that the transition to a diet including supplementary foods has shifted to a later age compared with the situation in 1995 (Hasunen *et al*, 1996).

The present study was part of the longitudinal Type I Diabetes Prediction and Prevention (DIPP) Nutrition Study, which aims at assessing the effects of nutritional factors in early childhood on the development of pre-type I diabetes. The purpose of the present study was to investigate infant feeding patterns during the first 2 y of life and their relation to parental education, maternal age, the number of siblings and the sex of the infant.

Subjects and methods

The present study is part of the Finnish Type I Diabetes Prediction and Prevention project (DIPP), which is an effort to predict and search for means to delay or prevent the disease in a large population-based cohort of children in Finland (Kupila *et al*, 2001). The DIPP Nutrition Study evaluates the role of dietary factors in the aetiology of childhood type I diabetes. All newborn infants (premature infants included) in the University Hospital areas of Oulu and Tampere with increased genetic risk for type I diabetes (HLA-DQB1 genotypes *02/*0302 and *0302/*x*, *x* ≠ *02, *0301, *0602) were considered for inclusion in the study. Infants with congenital abnormalities or diseases were excluded along with infants of families not understanding Finnish, Swedish or English. The children were monitored for diet, growth, viral infections, and type I diabetes-associated autoantibodies at 3–12 month intervals. In total, 675 newborn infants were invited in the follow-up between

September 1996 and December 1997. The dietary follow-up form was completed for 429 of them (64%) by the age of 2 y. All of the parents gave their written informed consent. Ethical approval for this study was obtained from the local Ethics Committees.

From the questionnaire completed at 3 months after delivery, the following information was obtained: parents' age, basic and vocational education, occupation, the number of siblings, the type of day care and the home province. The study comprised 242 male and 187 female infants (Table 1). Of the children 87% came from the district of the University Hospital of Oulu including 42 municipalities, and 13% from the district of the University Hospital of Tampere including 34 municipalities. The mean age of the mothers was 29.9 y (s.d. 5.2), and that of the fathers 31.7 y (s.d. 5.7). The basic education of both the mother and the father was combined as an estimate of parental education classified in relation to graduation from high school. The median number of siblings was 1 (range 0–15). The data on birth weight and height of the infants was taken from delivery hospital records. The mean ponderal index (calculated as weight/height³) at birth was 28.2 kg/m³ (range 17.9–40.6). The type of day care varied according to the age. At the age of 1 y most of the children (90%) were cared at home, 6% in a small size group, 3% in a kindergarten, and 1% did not specify the type of day care. At the age of 2 y, the proportions were 68, 15, 14 and 3%, respectively.

Parents were asked to mark down on the dietary follow-up form the age of the infant when exclusive and total breastfeeding were stopped and the age when the infant started to receive various supplementary foods. The dietary form was completed at home and the study nurse checked it at each follow-up visit when the infants were 3-, 6-, 12-, 18-, and 24-months old. A blank entry for food items was taken

Table 1 Characteristics of the cohort of Finnish infants

	n	%
<i>Gender</i>		
Male	242	56
Female	187	44
<i>Maternal age at delivery, y</i>		
<25	77	18
25–29	133	31
≥30	206	48
Missing data	13	3
<i>Parental education</i>		
Both <high school	145	34
One ≥high school	147	34
Both ≥high school	110	26
Missing data	27	6
<i>Number of siblings</i>		
None	171	40
One sibling	132	31
Two siblings or more	112	26
Missing data	14	3
Total	429	100

to indicate that such foods were not consumed before the age of 2y. In the present study, exclusive breastfeeding allowed for supplementation with water and vitamins (mainly vitamin D starting 2 weeks after delivery), but not for any formula meals or other supplementary foods.

The following food groups were used in the analysis: fruit and berries; root vegetables (potato and carrot); vegetables high in nitrate (spinach, beetroot, swede and turnip); gluten-containing cereals (wheat, barley, rye, oat); other cereals (rice, maize, buckwheat, millet); meat and meat products; sausage; fish and fish products; egg; and dairy products. These food groups together with the age when the first supplementary food was given were used in the statistical analyses to evaluate the associations among sociodemographic factors and feeding patterns. Median and range were used to describe the duration of breastfeeding and age at introduction of supplementary foods. Sociodemographic differences in feeding patterns were analysed with the nonparametric Mann–Whitney and Kruskal–Wallis tests. Dietary variables were also categorised according to the current Finnish recommendations (Hasunen *et al*, 1997) for a logistic regression model. Associations among categorised dietary variables and sociodemographic factors were analysed using χ^2 -tests. A multiple logistic regression analysis was carried out to estimate the independent contribution and the corresponding odds ratio (OR) of all sociodemographic factors. The SPSS 7.5 statistical package for Windows (SPSS Inc., Chicago, IL, USA) was used for the statistical analyses.

Results

The median duration of exclusive and total breast feeding and age at introduction of various foods are presented in

Table 2. All the infants were breast-fed. At the age of 1 month, 67% of the infants were exclusively breast fed, at the age of 3 months 37%, and at the age of 4 months 20%. Breastfeeding continued on average until the age of 7 months. The ponderal index at birth was inversely associated with the duration of total breastfeeding (OR 0.32, 95% CI 0.14–0.73, $P=0.007$). At the age of 10 months, 67% of infants had been introduced to dairy products (other than infant formula and infant food containing hydrolysed milk protein), and before the age of 1y the proportion was 94%. The timing of the introduction of supplementary foods was associated with the total duration of breastfeeding. In a partial correlation analysis (adjusted for parental education, maternal age, sex of the infant, number of siblings and ponderal index at birth), the age at introduction of supplementary foods was related to the duration of total breastfeeding; $r=0.351$, $P<0.0001$.

When infant formula was taken into account, the first food introduced was cow's milk formula for most (63%) of the infants. The other initial supplementary foods introduced were usually roots: potato and carrot started at a median age of 3.5 months (Table 2). At the ages 3, 4 and 6 months, 46, 88 and 100% of infants, respectively, were receiving some supplementary food (other than infant formula). The introduction of cereals usually started with oats. Only six children received cereals (mostly rice) together with roots and fruits as their first food introduced before the age of 5 months. Beef was generally the first meat product introduced (median age 5 months) followed by pork (median age 5.5 months) and poultry (median age 6 months). The last foods introduced were vegetables high in nitrates/nitrites and lettuce.

The level of parental education was associated with the duration of exclusive and total breastfeeding (Table 3).

Table 2 Median duration of exclusive and total breast feeding and ages at introduction of various foods in comparison with Finnish recommendations^a

	Median (months)	Range (months)	Recommendation (months) ^b	Proportion (%) receiving the food earlier than recommended
Duration of exclusive breast feeding	1.8	0–6.0	4–6	80
Duration of total breast feeding	7.0	0.3–25	12	85
Introduction of infant formula	1.8	0–25	4–6	65
First supplementary food	3.5	1.0–6.0	4–6	63
Potato/carrot	3.5	1.5–	4–6	59
Fruit/berries	4.0	1.0–6.5	4–6	48
Vegetables high in nitrates/nitrites	12	3.0–	12	35
Gluten-containing cereals (wheat, rye, barley, oat)	5.0	2.5–23	5–6	17
Other cereals (rice, maize, etc)	5.0	2.5–	5–6	32
Meat	5.0	3.5–	5–6	9
Sausage	12	5.0–	12	45
Fish ^c	7.5	4.0–	5–6	1
Egg	10	4.0–	5–6	1
Dairy products (other than supplementary milk feeding and food containing hydrolysed milk protein)	5.5	2.5–	10–12	67

^aHasunen *et al*, 1997.

^bThe number of infants was calculated according to the situation at the lower age of the recommendation.

^cThe number of infants was calculated according to the situation at the age of 6 months at the earliest.

Table 3 Adjusted relative odds of short duration of total breast feeding (<6 months), early introduction of infant formula (<2 months) and early introduction of other foods (<4 months)^a

	Short duration of breast feeding (<6 months)		Early introduction of infant formula (<2 months)		Early introduction of other foods (<4 months)	
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
<i>Education</i>						
One vs neither > high school	0.67 (0.41–1.1)	0.122	1.06 (0.65–1.73)	0.805	1.03 (0.62–1.72)	0.915
Both vs neither > high school	0.24 (0.13–0.44)	<0.0001	0.53 (0.31–0.90)	0.020	0.50 (0.29–0.85)	0.011
Maternal age	0.95 (0.90–1.0)	0.0345	0.99 (0.95–1.04)	0.800	0.94 (0.90–0.99)	0.015
Girls vs boys	0.80 (0.51–1.3)	0.336	0.70 (0.46–1.06)	0.091	0.48 (0.31–0.74)	0.0009
<i>Number of siblings</i>						
1 vs 0	1.35 (0.81–2.26)	0.250	1.02 (0.63–1.66)	0.937	1.04 (0.62–1.73)	0.884
2 or more vs 0	0.68 (0.37–1.28)	0.233	0.78 (0.44–1.38)	0.394	0.84 (0.46–1.52)	0.566

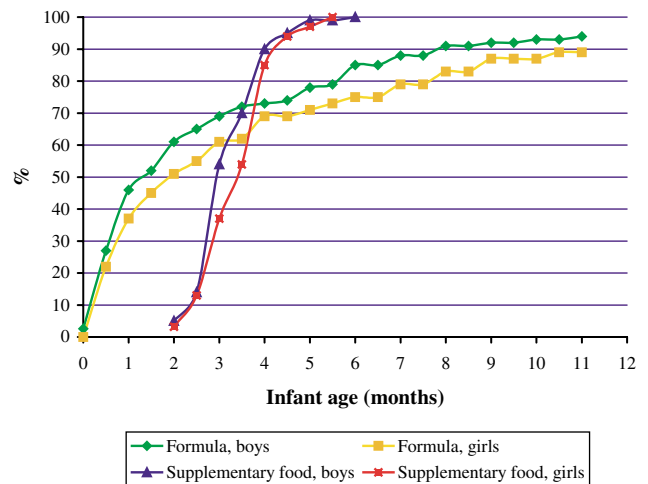
^aThe model contains all the variables in the table and is adjusted for the infant's ponderal index at birth. Statistically significant differences ($P < 0.05$) are indicated in bold type. Maternal age not categorized.

Infants in families where both parents had graduated from high school were exclusively breast-fed for longer than others (median 1.5 when both <high school, 1.5 when one \geq high school, and 2.8 when both \geq high school, $P = 0.010$); the duration of total breastfeeding also being longer (median 5.3, 6.0 and 8.5 respectively, $P < 0.001$). In the logistic regression analysis, the differences were obvious when comparing categories with the shortest and the longest education (Table 3). Highly educated parents started to introduce infant formula and other foods later than did parents with a shorter education (median 1.5 when both <high school, 1.5 when one \geq high school, and 2.8 when both \geq high school, $P = 0.022$). In the category of longest parental education, 31% of the infants had received supplementary food by the age of 3 months, the proportion being 45% when only one parent had graduated from high school, and 59% for the category of shortest parental education.

Maternal age was associated with the duration of breastfeeding and age at introduction of supplementary foods, more specifically with later introduction of the first supplementary food, vegetables high in nitrate, meat and meat products and sausage (Table 3).

Boys tended to be exclusively breast-fed for a shorter time than girls and infant formulas and other foods were introduced earlier than for girls (Table 3). Fewer boys than girls were breast-fed for at least the recommended 4 months (17 vs 25%, $P = 0.044$). Infant formula was added earlier to the diet of the boys than in girls (1.5 vs 2.0 months, $P = 0.033$, Table 3, Figure 1). Moreover, supplementary foods were given earlier to boys than to girls in this study population (medians 3.0 vs 3.5 months, $P = 0.001$, Figure 1). By the age of 3 months, 54% of boys and 37% of girls ($P = 0.001$) had been given supplementary foods.

There was a weak association between the number of siblings and the infant feeding patterns. In the case of the infant having one sibling, he/she started to receive vegetables high in nitrates earlier than infants with no siblings or with at least two siblings (median 12 months for all,

**Figure 1** Introduction of infant formula and other supplementary foods among boys and girls.

$P = 0.045$). Sausage was introduced earlier among infants with one or more siblings compared with infants with no siblings (median 11.8 vs 12 months, $P = 0.003$). The type of day care (kindergarten, small size group, or home) and the home province (Oulu as a northern province or Tampere as a southern province) did not influence infant feeding patterns.

Discussion

Results from the present study indicated that the duration of both exclusive and total breastfeeding is shorter than recommended among Finnish infants. Only 37% of the infants were introduced to supplementary foods earliest at the age of 4 months according to the national recommendation. The age at introduction of supplementary foods was positively associated with the duration of total breastfeeding. The present study also provided evidence for social differ-

ences in infant feeding patterns in Finland. There was an association between longer parental education and longer duration of breastfeeding and later introduction of infant formula and other supplementary foods. It was also noted that increasing maternal age was associated with a longer duration of breastfeeding and older age at introduction of supplementary foods. Infant formula and other supplementary foods were added earlier to the diet of boys than to that of girls, whereas the number of siblings had only a weak impact on the feeding patterns. The cohort of infants in the present study is expected to be representative of the population of Finnish infants.

The findings on the duration of total and exclusive breastfeeding are in line with results from other Finnish studies completed during the last decade (Hasunen *et al*, 1996; Räisänen *et al*, 1998; Tepora *et al*, 1999; Hasunen, 2002). Although the duration of exclusive and total breastfeeding is still shorter than recommended, a positive trend can be seen over the last 10 y. In the recent nationwide survey (Hasunen, 2002) a clear increase was noted in the duration of breastfeeding when compared with the situation in 1995, when the first national survey was performed (Hasunen *et al*, 1996). Breastfeeding rates have been increasing in most industrialised countries since the early 1980s, with the most conspicuous increases occurring in the Scandinavian countries, where breast feeding has been actively promoted (Koçtürk & Zetterström, 1999). Sweden has one of the highest rates of breastfeeding in the European Union (Freeman *et al*, 2000; Yngve & Sjöström, 2001a). The definition of exclusive breastfeeding in Sweden allows small portions of supplementary foods to be given to babies to taste, which could partly contribute to the high rates reported. In the present study, only water and vitamins were allowed during exclusive breastfeeding. The WHO definition of breastfeeding does not allow water during exclusive breast feeding and therefore the rates of breast feeding in the present study are not fully comparable with the results of studies using the WHO definition. The global public health recommendation of WHO to continue exclusive breastfeeding for the first 6 months (WHO, 2003) seems almost impossible to achieve in Western societies. In the present study, only three children (0.7%) were exclusively breastfed for that long.

The average age when supplementary foods are added to the infant diet has showed a wave-like trend over the last 30 y in Finland. In 1976, the introduction of solid foods began already at the age of 2 months (Virkkunen, 1978), in 1981–1982 the mean age at starting supplementary feeding was 3.5 months. The nationwide survey in 1995 (Hasunen *et al*, 1996) showed a slightly younger trend; most of the infants had supplementary foods at the age of 3 months. The results from a more recent nationwide survey (Hasunen, 2002), together with those from the present study, show that the trend has turned upward again, yet a gap remains between current practices and the recommendations. When comparing our results with similar estimates from the Euro-

Growth Study (Freeman *et al*, 2000) the impression is got that the age of 4 months is a more important milestone for Finnish mothers than for other European mothers in relation to starting to introduce supplementary foods. In Finland there is a clear peak at the age of 4 months, whereas the variation was wider in the countries included in the Euro-Growth Study.

The finding that the age at introduction of supplementary foods was positively associated with the duration of total breastfeeding is in concordance with results from earlier studies (Freeman *et al*, 2000). It has been reported (Dewey, 2000) that breast-fed infants decrease their intake of breast milk when given other foods and fluids. It remains difficult, however, to differentiate between the cause and consequence. In the study by Whichelow (1982), the most common reason for weaning before 6 months was insufficient breast milk supply. Sufficient breast milk is not the only determinant; weaning practices are handed down from family and friends and are intuitive rather than informed (Daly *et al*, 1998).

There are a lot of controversies regarding the optimal diet during the later half of infancy, from 6 to 12 months of age. The recommendations vary considerably among different countries indicating that tradition often plays a stronger role than science (Michaelsen, 1997). The order in which feeding specific foods begins varied among study centres in the Euro-Growth study (Freeman *et al*, 2000). For the majority of infants, fruits and cereals were introduced first and milk products last, whereas in the present study, potato was the first and special nitrate containing vegetables were the last foods to be introduced. Although the typical Finnish diet nowadays includes less milk than before (Lahti-Koski & Kilkkinen, 2001), the consumption of milk products is quite high in comparison with other European countries. A strong tradition favouring the use of milk products might partly explain the early introduction of dairy products to Finnish infants, the gap in relation to the recommendations being almost half a year. For most of the infants cow milk protein is the first foreign protein introduced. In ready to eat infant foods recommended for children less than 10 months of age the milk protein is usually partly hydrolysed to render it less harmful to the developing gut. Early introduction of pasteurised cows' milk has been associated with a higher incidence of iron deficiency anaemia due to its low iron content (Daly *et al*, 1998). The risks of developing type I diabetes (Virtanen & Knip, 2003) and allergic reactions (Chandra, 2002) might increase when introducing cows' milk during early infancy.

The results of this study demonstrated that parental education and maternal age are strong sociodemographic determinants of the diet in Finnish infants. These are the same as for most other Western societies (Yngve & Sjöström, 2001b). There is an inter-relationship between young age and poor education, since education of young people is in many cases still continuing. Differences in the type of diet in relation to education and age become more obvious already

during pregnancy (Erkkola *et al*, 1998). Nutritional guidance given at maternity clinics does not seem to be able to even out the differences in diet based on parental education and maternal age. Even though more effective guidance at maternity clinics would be available, some mothers still do not have personal recourses to follow the guidance. The average maternal age at delivery is close to 30 y in Finland, but there is a trend towards an increasing proportion of both mothers younger than 20 y and older than 35 y (Vuori & Gissler, 2001).

According to the results of the present study, infant formula and first supplementary food were introduced earlier among boys than among girls. Similar findings were reported in recent surveys done in Norway (Pande *et al*, 1997) and Australia (Scott, 1999), but also contradictory observations have been reported (Van den Boom *et al*, 1993; Savage *et al*, 1998; Hörnell *et al*, 1999). Sex differences in weaning might reflect a hidden social stereotype of boys needing to grow faster than girls. Infants triple in weight and increase in length by 50% during the first year of life. Earlier studies have shown that parents of heavier infants wait longer to introduce solid foods (Dewey *et al*, 1995), though this was not confirmed in the present study. Data from a cross-sectional study in Bavaria suggested that the risk of obesity in children at the time of school entry could be reduced by breastfeeding. The effect was more likely to be related to the composition of breast milk than to lifestyle factors associated with breastfeeding (Von Kries *et al*, 1999). Low weight gain in infancy is linked to cardiovascular disease only in men (Osmond *et al*, 1993), whereas rapid weight gain is linked to type I diabetes in both men and women (Hyppönen *et al*, 1999).

In the present study, the number of siblings showed only weak association with feeding patterns. The finding that there is a longer duration of total breastfeeding among children with at least two siblings differs from earlier studies in which duration of breastfeeding increased with a second child, but not significantly so with a third (Nagy *et al*, 2001). Although the number of siblings was not correlated with the age at introduction of first supplementary foods, it might be assumed that shifting to a diet with a wide selection of foods is accelerated in families with more than one child. That could explain the earlier introduction of sausage and vegetables high in nitrates to infants with siblings.

The self-completed dietary follow-up form used in the present study might have had some weaknesses. Some parents completed the form retrospectively, not prospectively as was instructed. The exact time when supplemental foods were introduced is not necessarily easily remembered. Recall problems were minimised by checking the form at each follow-up visit. It is difficult to get accurate information on breastfeeding (Williamson, 1989). Breastfeeding may taper off gradually and may not have a clear end point. There are also definitional problems. Is the food given in addition to breast milk a supplement or a substitute for breast milk? It was assumed that exclusive breastfeeding

ended as soon as the child got the first drop of something else besides water or vitamin supplements.

In the present study, we focused on sociodemographic determinants of breastfeeding and weaning during the first 2 y. The diet during infancy seems to be strongly influenced by the length of parental education and maternal age. Male infants were more likely to be weaned earlier than female infants. The breast-fed infant has been claimed to be the reference against which all alternative feeding methods must be assessed. The likelihood of becoming a representative of the reference group is not the same for all newborn infants in Finland.

Acknowledgements

The authors thank Jonathan Robinson for language editing. The DIPP Nutrition Study was supported by the Academy of Finland, the Finnish Diabetes Association, the Finnish Diabetes Research Foundation, the Finnish Pediatric Research Foundation, the Häme Foundation of the Finnish Culture Fund, the Juho Vainio Foundation, the Medical Research Found of Tampere University Hospital, and the Yrjö Jahnsson Foundation. The DIPP Core Study was supported through grants of professors J Ilonen, M Knip and OG Simell by Medical Research Funds, Turku, Oulu and Tampere University Hospitals, the Targeted Program of the Academy of Finland, the Sigrid Jusélius Foundation and the Juvenile Diabetes Research Foundation on Type I Diabetes, the Juvenile Diabetes Research Foundation (Grants 197032 and 4-1998-274), Novo Nordisk Foundation and EU Biomed 2 Program (BMH4-CT98-3314). We express our gratitude to the children and parents who participated. We want to thank the DIPP research nurses, doctors, nutritionists and laboratory staff for excellent collaboration over the years. We are also grateful to Sirpa Pohjola for her skilful technical assistance. Thanks must also be expressed to Mikko Virtanen for his valuable comments on statistical issues.

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