

# Types of drinks consumed by infants at 4 and 8 months of age: a descriptive study

Pauline Emmett\*, Kate North, Sian Noble and the ALSPAC Study Team  
Unit of Paediatric and Perinatal Epidemiology, 24 Tyndall Avenue, Bristol BS8 1TQ, UK

Submitted 10 April 1999; Accepted 24 November 1999

## Abstract

**Objective:** To document the type and volume of drinks given to infants and investigate whether giving supplementary drinks leads to reduced milk consumption.

**Design:** Carers were asked to record all drinks consumed by the infants in a 24-hour period at two ages, detailing the types and volume taken.

**Setting:** The Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC).

**Subjects:** A randomly chosen population sample of over 1000 infants at 4 and 8 months of age.

**Results:** The different types of milk feed were used to group infants, compare volumes consumed and look at the use of non-milk drinks. The average volume of drinks consumed over 24 hours at 4 months was 861 ml and at 8 months was 662 ml. At 4 months 69.7% consumed infant formula and 43.0% breast milk. The mean volume of milk consumed by those having only formula was 802 ml and for those having only breast milk was estimated at 850 ml. The volumes of milks consumed were slightly lower in the groups who also had supplementary drinks. A quarter of infants were given fruit drinks and 14.6% herbal drinks. Supplementary drinks and solids were more likely to be given to formula-fed than breast-fed infants. At 8 months, formula milk was consumed by 71.4% and breast milk use had decreased (22.9%) but fruit drink use had increased (squash/cordial: 55.8%, fruit juice: 14.9%), with 13.9% of infants having no infant milk at all. More infants were fed formula milk and less were fed cows' milk compared with a nationally representative British study conducted 5 years earlier.

**Conclusions:** Many infants were given supplementary drinks by 4 months; there is some evidence that this led to a small reduction in milk intake. A minority were not being given infant milks at all by 8 months, contrary to British infant feeding recommendations.

**Keywords**  
Breast milk  
Formula  
Supplementary drinks

There are few quantitative surveys of the drinking habits of young British children, particularly of those under 1 year old. The Ministry of Agriculture, Fisheries and Food (MAFF) produced a report examining the general diet of infants aged 6–12 months<sup>1</sup>, the fieldwork for which was carried out in 1986. However, this concentrated primarily on nutrient intakes and infants under 6 months were not assessed at all.

In Britain, since 1975, infant feeding surveys have been carried out every 5 years which provide information on the use of breast milk, formula and other drinks. The 1990 and 1995 surveys administered postal questionnaires to a representative sample of mothers of 6–10-week-old infants in England, Wales, Scotland and Northern Ireland which asked about infant feeding<sup>2,3</sup>. Two further questionnaires were sent when the infant was 4 and 9 months old, thus following the progress of the infant from an all milk diet to a mixed diet. These surveys did not, however, collect quantitative information about the volumes of drinks consumed.

Many countries have published recommendations for infant feeding and in Britain two reports have been produced by the government in the last 10 years. The first, *Present Day Practice in Infant Feeding*, published in 1988, made recommendations about the types of milks to be given to infants and the age of introduction of solids<sup>4</sup>. The second, *Weaning and the Weaning Diet*, published in 1994, extended the process further and focused on many of the problems of changing from a milk-based diet to a mixed diet<sup>5</sup>. Recommendations about infant feeding were more explicit in this second report. Both reports suggest that breast milk or alternatively modified infant formula should be used as a main drink in preference to cows' milk. The 1994 report stated that cows' milk should not be used in this way until after the age of 1 year, though this was not based on firm evidence of advantage to the developing child.

There is concern over the increasing trend for infants to be given fruit drinks, often in place of breast or formula milks, as this could lead to a deficiency in calcium. When

\*Corresponding author: Email: p.m.emmett@bristol.ac.uk

studying a very small group of children who had been referred for failure to thrive, Hourihane and Rolles noted that drinking large amounts of squashes and juices could be detrimental to the child's health<sup>6</sup>. A study of 105 2–7 year olds in Southampton concluded that large quantities of squash were consumed in place of plain drinking water<sup>7</sup>. Excess consumption of squashes and fruit juices has also been reported<sup>8–10</sup>. In the USA, Dennison found that the consumption of more than 336 ml (12 fl oz) of fruit juice a day was associated with shortness of stature and obesity in a group of otherwise healthy 2 and 5 year olds<sup>9</sup>. Furthermore, the consumption of sugary fruit squashes and carbonated drinks was shown to influence the development of tooth decay by MAFF in their dental survey of 1992/93, particularly in children aged 2.5–3.5 years<sup>11</sup>.

The consumption of some other drinks has also been shown to have adverse effects, for example, Disler *et al.* found that, in adults, drinking tea with a meal reduced the absorption of iron from the food<sup>12</sup>. Further, Merhav *et al.* studying 122 children aged 6–12 months found tea drinkers to have a higher prevalence of microcytic anaemia than non-tea drinkers<sup>13</sup>.

This study uses dietary records to explore the volume and variety of drinks consumed by a cohort of infants at 4 months and again at 8 months. This is the first survey of this kind since the 1988 recommendations were published in the UK and it will be important to assess whether any movement has been made towards improved weaning patterns. Since it is recommended that milk should be the main contributor to the diet of infants of this age, the analysis focuses on the various combinations of milks consumed.

## Methods

The data for this study were obtained from ALSPAC: a prospective cohort study designed to identify features of the environment which influence the health and development of children<sup>14</sup>. Pregnant women who had an expected date of delivery between 1 April 1991 and 31 December 1992 and who were resident in the three Bristol-based health districts of the county of Avon, in southwest England, were eligible for the study. Between 80% and 90% of eligible mothers enrolled for the study resulting in 14 893 pregnancies. Compared to the 1991 National Census data of mothers with infants under 1 year who were resident in Avon, the ALSPAC population demonstrated a slight shortfall in those living in rented accommodation, those without a car, single parent families and unmarried cohabiting couples. There was also a smaller proportion of ethnic minority mothers. In-depth information was obtained from a randomly chosen 10% sample of ALSPAC children, born between June and December 1992, known as the 'Children in Focus' cohort. These

children were invited to several clinics at specific ages during their early years. The mothers of those attending the clinics when compared to the whole ALSPAC sample showed a bias towards the higher educational groups, older mothers and those in owner-occupied accommodation.

Appointments were made for each child and their main carer to attend a clinic when the child was 4 months old and again at 8 months of age. As part of the clinic assessment carers were invited to record in a structured diary all foods and drinks their child consumed over a 24-hour period. The carers were asked to bring their completed diaries to the respective clinics, and at the 8-month clinic they were interviewed by a member of the ALSPAC nutrition team to clarify any anomalies in the diary.

All drinks consumed were recorded in a specifically designed section of the diary separate from the foods. There was a separate section in the diary enquiring about breast-feeding including the timing and duration of each feed. There were also individual sections for bottle-feeding, asking for the types and volumes of infant formula and other milks used and for all other drinks given. The volume of the amount offered and the amount left by the infant was recorded in fluid ounces, this was facilitated by the markings on the feeding bottles used by the majority of mothers.

For breast milk the duration of each feed was used to estimate the likely volume of milk, the basis of the calculation differed at each age and used previously validated assumptions<sup>1,15</sup>. At 4 months, 125 ml was allowed for a feed lasting 10 min or longer and a percentage of 125 ml for shorter feeds (i.e. 12.5 ml of breast milk min<sup>-1</sup>). At 8 months a feed lasting 10 min or longer was assumed to be 100 ml in volume and a proportion of this if the feed was of shorter duration (i.e. 10 ml min<sup>-1</sup>).

## Results

### Subjects

Of the 1276 singleton infants who attended a clinic at 4 months of age (82.6% of those invited), 933 (73.1%) had dietary records completed for them which were suitable for analysis. Of the 1320 infants who attended a clinic at 8 months of age (83% of those invited), 1178 (89%) had dietary records completed for them; these included one child from each of 15 sets of twins. A total of 781 attended both clinics and provided reliable diaries each time.

### Drinks consumed at 4 months

Formula milk was the drink most frequently consumed at 4 months of age as shown in Table 1; 69.7% of infants had at least one formula feed over the 24-hour period. Soya formula was included in this category, although only 10

**Table 1** The proportion of infants consuming various drinks at 4 and 8 months of age from records of dietary intake kept by the carers of 933 infants at 4 months and 1178 infants at 8 months of age

Drink type	% at 4 months	% at 8 months
Formula milk	69.7	71.4
Breast milk	43.0	22.9
Cows'/animal milk	<1.0	21.8
Water	8.7	19.7
Fruit drinks	24.2	
Squash/cordial		55.8
Juice		14.9
Diet squash		6.4
Herbal drinks	14.6	9.8
Tea/coffee	<1.0	3.2
Warm drinks (other than tea/coffee)	<1.0	0.1
Cold flavoured milk drinks		<0.1
Fizzy drinks		<0.1
Gripe water	2.4	0.3

infants were given this. Forty-three per cent of infants were recorded as having at least one breast feed. Additional non-milk drinks were consumed by a quarter of the sample: fruit drinks including squashes, black-currant drinks and ready prepared baby drinks were the most popular, followed by herbal drinks (e.g. orange and camomile, apple and fennel) and herbal teas. Only one child consumed whole pasteurized cows' milk at some point during the 24-hour period, another had tea and one other child had cocoa on the day of recording.

### Drinks consumed at 8 months

In Table 1 the proportion of children consuming each type of drink at 8 months is shown. The category 'formula milk' included 25 children who were having soya formula. The squashes/cordials group included commercial baby fruit drinks and Ribena. The animal milks consumed were mainly whole cows' milk; however, two children had skimmed, five had semi skimmed and two had goats' milk at some point during the day. Formula milk was still the most commonly used drink; 71.4% of the children had been given it at least once. Squashes/cordials were drunk by 55.8%; breast milk, cows' milk and water were each given to approximately 20% of the children.

### Milk type groups

At 4 months, infants were grouped according to the types of milk consumed: breast milk, formula milk or a combination of the two, and also whether supplementary drinks (including water) were given. Table 2 shows that the most frequent combination of drinks was that of formula milk and other drinks (34.2%). Almost a quarter of infants were exclusively breast-fed and an almost identical number were exclusively formula-fed, that is, they were having no other drinks (but they may have been having solids). A larger proportion of infants having breast milk received no other drinks compared to those who were having formula as their only milk.

**Table 2** The frequency of consumption of various drink combinations by infants at 4 months of age

Drink combination	Frequency (%)
Breast milk only	213 (22.8%)
Breast milk and other drinks	70 (7.5%)
Formula milk only	215 (23.0%)
Formula milk and other drinks	319 (34.2%)
Breast and formula milk only	68 (7.3%)
Breast and formula milk and other drinks	48 (5.1%)
Total	933 (100.0%)

At 8 months, the infants were again grouped according to milk type but in a slightly different manner. By this age cows' milk or other animal milk was sometimes used as a main drink in place of formula or breast milk so a separate category was included to cover this. It should be noted that all infants at 8 months were having supplementary (non-milk) drinks and solids. Table 3 shows the proportion of children within each of these milk types. The milk in the category 'animal milk' was primarily whole cows' milk, but included goats' milk, semi-skimmed and skimmed cows' milk. Over half the children were being given formula as their only source of milk, but 1% received no milk drinks at all. Four mutually exclusive categories were created based on the types of milks consumed, including a 'no baby milk' group (those having no breast or formula milk), as indicated in the right hand column of Table 3.

### Volume of drinks

At 4 months of age the average volume of fluid consumed over a 24-hour period was 861 ml. There were significant differences between milk type groups in the total average volume of all drinks consumed over the 24-hour period ( $P < 0.0001$ ) as shown in Table 4. Infants having a combination of breast milk, formula milk and other drinks were consuming the largest average volume, whilst those having only formula milk were consuming the least. There was no difference in the total volume consumed between breast-fed infants with or without supplementary drinks, but formula-fed infants who were receiving supplementary drinks were having a significantly greater overall average volume of fluid compared

**Table 3** The frequency of consumption of various types of milk by infants at 8 months

Drink combination	Frequency (%)	Milk type group
Animal milk only	152 (12.9%)	No baby milk
Breast milk only	149 (12.6%)	Breast milk
Formula milk only	673 (57.1%)	Formula milk
Animal and breast milk only	34 (2.9%)	Breast milk
Animal and formula milk only	77 (6.5%)	Formula milk
Breast and formula milk only	81 (6.9%)	Breast/formula
No milk	12 (1.0%)	No baby milk
Total	1178 (100.0%)	

**Table 4** Comparing the average volume (ml) of milks and other drinks consumed by infants at 4 months of age according to the combination of milks given

Drink combination	Total mean volume of all drinks (SD)	Mean volume of milks (SD)	Mean volume of non-milk drinks (SD)
Breast milk only	850 (226)	850 (226)	–
Breast milk and other drinks	857 (227)	787 (227)	70 (73)
Formula milk only	802 (186)	802 (186)	–
Formula milk and other drinks	894 (223)	780 (226)	114 (97)
Breast and formula milk only	887 (257)	887 (257)	–
Breast and formula milk and other drinks	927 (258)	833 (241)	94 (89)
F-statistic*	5.21, $P < 0.0001$	4.99, $P < 0.0001$	132.79, $P < 0.0001$

\*From analysis of variance.

with those having formula only. Infants who were being given supplementary drinks had a significantly lower average milk intake ( $P < 0.0001$ ), ranging from 22 ml less formula milk to 63 ml less breast milk. The greatest volume of non-milk drinks were consumed by those infants having formula milk while those who were breast-fed had the smallest volume; these differences were highly significant ( $P < 0.0001$ ).

At 8 months the average volume of drinks consumed by the infants in 24 hours was 662 ml. Table 5 shows the average total volume of drinks consumed according to the types of milk given at this age. Infants who received no baby milk consumed on average the largest total volume – this extra volume was from non-milk drinks. They consumed significantly more than all the other three groups ( $P < 0.0001$ ). There was no significant difference between the other breast- and formula-fed groups in the volume of non-milk drinks consumed, but the estimated volume of breast milk consumed was less than the volume of formula recorded. Compared with the other groups, infants who were not having any baby milk in their diet did not consume any less milk (animal) by volume.

### Solids

Of the 933 children in the sample at 4 months, only 103 (11.0%) were not having any solids in their diet. A significantly lower proportion of children drinking only breast milk were having solids (79.9%) compared to those having only formula milk (92.7%) or a combination of breast and formula (94.0%) ( $P < 0.0001$ ). By 8 months of age, all children were having solids.

### Milk type transition

The longitudinal nature of the ALSPAC study allows the investigation of transitions of infant feeding. Of those infants who were being breast-fed at 4 months of age and for whom we had information at 8 months, around half were no longer having breast milk by 8 months. Table 6 shows the types of milk consumed by children at 8 months according to the type they were receiving at 4 months. Of those having only breast milk at 4 months of age 8.0% were having no form of baby milk compared with more than double proportion for those having only formula milk at 4 months.

### Discussion

All infants were receiving some form of baby milk – either breast or formula or both – at 4 months of age, although a substantial proportion were having additional drinks; these were mainly in the form of fruit and herbal drinks.

The use of flavoured drinks (fruit and herbal) was much greater than that of plain boiled water which is the recommended supplementary drink for young infants<sup>4,5</sup>. In fact only a small proportion of the infants were having plain water at 4 months of age. The dietary diaries did not enquire as to whether this water was boiled and cooled before consumption nor whether the water used to dilute other drinks had been boiled and cooled. Infants of this age who are given adequate breast milk do not require supplementary fluids<sup>16</sup> and since the 4-month dietary diaries were collected in the winter months of October to March no seasonal effects of warmer weather causing dehydration and increased need for fluid would be expected.

**Table 5** Comparing the average volume (ml) of milks and other drinks consumed by infants at 8 months of age according to the types of milk given

Drink combination	Total mean volume of all drinks (SD)	Mean volume of milks (SD)	Mean volume of non-milk drinks (SD)
No baby milk	714 (248)	485 (231)	229 (163)
Breast milk	551 (197)	388 (175)	162 (140)
Formula milk	679 (215)	499 (172)	180 (134)
Breast and formula	654 (227)	490 (201)	164 (135)
F-statistic*	20.57, $P < 0.0001$	17.30, $P < 0.0001$	6.35, $P < 0.0001$

\*From analysis of variance.

**Table 6** Proportion of children having various combinations of milks at 8 months of age according to the milks received at 4 months of age

Type of milks consumed at 8 months	Breast milk only at 4 months (n)	Formula milk only at 4 months (n)	Breast and formula at 4 months (n)
No baby milk	8.0% (20)	17.5% (76)	10.3% (10)
Breast milk	48.2% (120)	–	3.1% (3)
Formula milk	24.1% (60)	82.5% (359)	72.2% (70)
Breast and formula	19.7% (49)	–	14.4% (14)

$\chi^2 = 425.61$ ,  $P < 0.0001$

In this study the use of supplementary drinks at 4 months of age was much lower than that found in the 1990 infant feeding survey where at 6 weeks only 21% were receiving no additional drinks<sup>3</sup>. It may be that we have underestimated drink consumption by using only 1 day's recording rather than a questionnaire. However, this study showed a similar differential to that found in the infant feeding survey between breast- and bottle-fed infants in the use of drinks – only 24.7% of breast-fed infants had additional drinks compared with 59.7% of formula-fed infants. This disparity may be due to the fact that mothers who breast feed do not necessarily have bottles, teats and sterilizing equipment to hand so tend not to find it as convenient to give supplementary drinks as those who use bottles every day.

By 4 months of age, 92.7% of the formula-fed infants in this study were being given solids as well as milk; however, a smaller proportion of breast-fed infants (79.7%) were having solids. The 1988 British recommendations for infant feeding suggest that 'very few infants will require solid foods before the age of 3 months'<sup>4</sup>, however, by 1994 the recommendation had been strengthened to 'the majority of infants should not be given solid food before the age of 4 months'<sup>5</sup>, which is clearly not the case in this study. In the 1995 infant feeding survey 56% of infants had been introduced to solids by 3 months and 91% by 4 months, and a differential between breast- and formula-fed infants similar to that found in this study was also apparent.

The majority of the infants at 8 months of age were receiving the types of milk recommended by the 1988 report, which states that, 'milks considered suitable for inclusion in the diets of infants from the sixth month are human milk, infant formulas, follow-up milks and whole pasteurised cows' milk'<sup>4</sup>. Only 12.9% of these infants were receiving no form of baby milk (breast or formula) and a further 1.0% were receiving no milk drinks – however these infants were having milk with cereal or in puddings, but in four of these cases the milk used was skimmed or semi-skimmed milk, neither of which are recommended for infants of this age. The 1994 British report *Weaning and the Weaning Diet* states that 'whole cows' milk should only be used as a main drink after the age of 1 year'<sup>5</sup>. Clearly, this was not the case for all infants in this study; further investigation will be necessary to determine

whether there were any detrimental effects on the health or development of these infants. The 1990 infant feeding survey had shown a drop in the use of cows' milk and an increase in formula for 9–10-month-old infants between 1985 and 1990<sup>2</sup>. Our data is in line with this trend: 71% of infants in this study were having formula at 8 months compared to 57% of 9–10 month olds in 1990 and 32% in 1985. Furthermore the MAFF survey of 1986 recorded only 52% of 6–9 month olds consuming formula milk with 74% having cows' milk. Clearly our study represents an improvement in weaning practices.

Supplementary drinks were consumed by the majority of children although plain water was more popular by 8 months of age than it had been at 4 months: 19.7% of the sample received it. Squashes (including blackcurrant juice and baby fruit drinks) were consumed by 56% of the children. This is very much in line with the findings of Petter *et al.* where squash was the most popular drink of preschool and infant children<sup>7</sup>. This may lead to children being conditioned at a very early age to sweet-tasting drinks.

At first sight it would seem that a smaller proportion of our mothers (8.7% at 4 months and 19.7% at 8 months) gave water to their infants compared with those in the 1995 infant feeding survey which had 41% giving water at 4–5 months and 59% at 8–9 months<sup>3</sup>. This may be due to the fact that in this study we analysed a 1-day recording of actual intake whereas the national survey asked: 'do you give your baby plain tap water or mineral water to drink at the moment?'. This more open-ended question might tend to illicit a positive response even if water is rarely given and give a misleadingly high positive result. Certainly flavoured water drinks such as squash were recorded more often than plain water in this study.

The use of herbal drinks for infants in the ALSPAC sample was in line with that in the infant feeding surveys, these showed a decline in use at 4 months from 41% in 1990 to 9% in 1995 and at 8–9 months from 27% to 5%, respectively<sup>2,3</sup>. Our recorded use made in 1992/93 of 14.6% at 4 months and 10.9% at 8 months falls between the two to the respective ages.

The volumes of breast feeds were estimated using the duration of the feed and are therefore less accurate than the information collected about the volumes of other drinks. The calculation used for the estimation was

different at 4 and 8 months. At 4 months the estimated volume of breast milk corresponds very closely to the volumes of formula recorded but at 8 months the estimated volume of breast milk was somewhat lower than the recorded volumes of other milks. From the studies by Paul *et al.*, measuring the breast milk intake of infants by test weighing before and after every feed for 4 days each month, the mean breast milk intake for 24 hours at 4 months was 813 g for boys and 741 g for girls, whereas by 8 months it was 340 g and 367 g, respectively<sup>15</sup>. The estimates used in this study yielded mean volumes which were comparable with these figures, assuming that 1 ml of water-based fluid weighs approximately 1 g. Furthermore the volumes of breast milk and formula at 8 months in this study were very close to the amounts obtained in the 6–9-month group of the MAFF survey (using the same method of assessment)<sup>1</sup>, where breast milk intake for consumers was estimated at a mean of 381 g day<sup>-1</sup> and for formula at 504 g day<sup>-1</sup>. The mean amounts of other drinks in the MAFF survey was 194 g day<sup>-1</sup>, a level similar to that obtained in this study. Thus it would seem that the volumes obtained in this study are sensible.

At 4 months, the volumes of liquids consumed were similar between breast- and formula-fed infants, although a larger number of individual feeds were given to breast-fed infants. Children who were given breast milk had a significantly smaller volume of non-milk drinks compared to formula-fed infants.

The review by Dennison on infant fruit juice consumption in the USA emphasizes concern that the increase in fruit juice intake between 1957 and the 1990s has led to a decline in milk drinking and hence a reduction in the level of calcium in the diet<sup>8</sup>. In our study, 4-month-old children having supplementary drinks were taking slightly less milk (22–63 ml less, approximately 10–25 mg calcium) than those having milk alone. The rate of calcium retention necessary in early infancy is about 160 mg day<sup>-1</sup>. For breast milk it is estimated that about 66% of calcium is absorbed while for formula this is around 40%<sup>17</sup>. Therefore breast milk needs to supply 240 mg of calcium day<sup>-1</sup> and formula 400 mg day<sup>-1</sup>, in order to meet the infant's nutritional requirements. The mean volume of breast milk estimated in this study at 4 months would supply 289 mg of calcium day<sup>-1</sup> in those having only breast milk and 286 mg day<sup>-1</sup> in those having supplementary drinks with breast milk. The mean volume of formula milk consumed, assuming an average 60 mg per 100 g calcium content, would supply 481 mg calcium day<sup>-1</sup> for those children having only formula and 468 mg day<sup>-1</sup> for those also having additional drinks. Therefore, it is likely that infants in this study were receiving satisfactory levels of calcium in their diet even when supplementary drinks were given.

At 8 months, the infants in the 'no baby milk' group had a higher intake of non-milk drinks compared to all the other groups (ranging from an extra 49 to 67 ml day<sup>-1</sup>). It is possible that this could be a natural adaptation to the

higher solute load imposed by drinking an average 485 ml of unmodified cows' milk each day<sup>18</sup>. However, there was no difference in the volume of milk consumed by this group when compared with those who drank formula milk. The group of infants having no baby milk included a small number who consumed no milk drinks at all (although they were all having milk with cereal). These children may be vulnerable to calcium deficiency. From questionnaire data obtained from the mothers of the whole ALSPAC sample, when their child was 15 months of age fruit drinks were increasingly used (74% of the children were having some form of fruit drink; more specifically 31% were consuming apple juice and 56% were having other fruit juices, while 42% consumed blackcurrant juice or rosehip syrup and 57% were having other fruit-flavoured drinks, such as squashes). As the children get older the group replacing milk drinks with fruit drinks will increase in number thus a larger group of children may become vulnerable to low calcium intake.

We have little evidence that tea drinking by infants was widespread. At 8 months of age there were only 3.2% consuming tea (or coffee), therefore the effect of its tannin content on iron absorption at this young age is limited to a very small section of the population<sup>12,13</sup>. However, from the questionnaire data at 15 months, 33% were regularly consuming tea so as children grow up it could become an increasing problem. Caffeine-containing drinks were also more popular by 15 months of age, with 6% having coffee and 12% having cola. Just under 2% of the infants at 15 months were having decaffeinated versions of these drinks. It will be important to investigate caffeine intake in later childhood and the longitudinal component of the ALSPAC study will facilitate this. A significant proportion of infants were being given herbal drinks (14% at 4 months and 10% at 8 months). The pharmacological effects of some of these plant-derived chemicals on infants is not understood.

Of those children having formula milk at 4 months of age, a greater proportion were not receiving any form of baby milk by 8 months compared with children who had been breast-fed at 4 months. Formula-fed infants were also much more likely to have had solids by 4 months than breast-fed infants. Both these practices may lead to the development of iron deficiency<sup>19–21</sup>. Investigation of the iron status of this cohort in future studies will add to knowledge in this important area of child health.

The results of this study suggest that the levels of supplementary drinking in infants were high. Further analysis is required to determine whether this is at all harmful to the developing infant. We intend to examine the effects of this on the growth and dentition of the ALSPAC cohort. In a parallel analysis we are charting the socioeconomic characteristics of mothers using supplementary drinks and inappropriate milks for their young infants, thus enabling the provision of health care, support and education to be targeted more accurately once the

long-term benefits and hazards of current recommendations are known.

### Acknowledgements

We are extremely grateful to the Children in Focus parents and children who have taken part in this study and to the midwives for their cooperation and help in recruiting the mothers during pregnancy. We would like to acknowledge the dedicated work of the ALSPAC study team – this includes interviewers, computer technicians, clerical workers, research scientists, volunteers and managers. We would particularly like to thank the staff of the Children in Focus research clinics and the students who coded the drinks' data. This study has been supported by the Department of Health and Cow and Gate. The ALSPAC study is part of the WHO initiated European Longitudinal Study of Pregnancy and Childhood. The Children in Focus substudy is, however, unique to ALSPAC.

### References

- 1 Mills A, Tyler H. *Food and Nutrient Intake of British Infants Aged 6–12 months*. London: HMSO, 1992.
- 2 White A, Freeth S, O'Brien M. *Infant Feeding 1990*. London: HMSO, 1992.
- 3 Foster K, Lader D, Cheesebrough S. *Infant Feeding 1995*. London: HMSO, 1997.
- 4 Department of Health and Social Security. *Present Day Practice in Infant Feeding: Third Report*. Report on Health and Social Subjects No. 32. London: HMSO, 1988.
- 5 Department of Health and Social Security. *Weaning and the Weaning Diet*. Report on Health and Social Subjects No. 45. London: HMSO, 1994.
- 6 Hourihane JO'B, Rolles CJ. Morbidity from excessive intake of high energy fluids. The squash drinking syndrome. *Arch. Dis. Child.* 1995; **72**: 141–3.
- 7 Petter LPM, Hourihane JO'B, Rolles CS. Is water out of vogue? A survey of the drinking habits of 2 to 7 year olds. *Arch. Dis. Child.* 1995; **72**: 137–40.
- 8 Dennison BA. Fruit juice consumption by infants and children: a review. *J. Am. Coll. Nutr.* 1996; **15**: S4–11.
- 9 Dennison BA, Rockwell HL, Baker SH. Excess fruit juice consumption by pre-school aged children is associated with short stature and obesity. *Pediatrics* 1997; **99**: 15–22.
- 10 Smith MM, Lifschitz F. Excess fruit juice consumption as a contributing factor in nonorganic failure to thrive. *Pediatrics* 1994; **93**: 438–43.
- 11 Hinds K, Gregory JR. *National Diet and Nutrition Survey: Children Aged 1½ to 4½ Years, Vol. 2: Report of the Dental Survey*. London: HMSO, 1995.
- 12 Disler PB, Lynch SR, Charlton RW, *et al.* The effect of tea on iron absorption. *Gut* 1975; **16**: 193–200.
- 13 Merhav H, Amitai Y, Palti H, Godfrey S. Tea drinking and microcytic anaemia in infants. *Am. J. Clin. Nutr.* 1985; **41**: 1210–13.
- 14 Golding J and the ALSPAC study team. Children of the nineties: a resource for assessing the magnitude of long-term effects of prenatal and perinatal events. *Contemp. Rev. Obstet. Gynaecol.* 1996; **8**: 89–91.
- 15 Paul AA, Black AE, Evans J, Cole TJ, Whitehead RG. Breastmilk intake and growth in infants from two to ten months. *J. Hum. Nutr. Diet* 1988; **1**: 437–50.
- 16 Goldberg NM, Adams E. Supplementary water for breastfed babies in a hot and dry climate – not really a necessity. *Arch. Dis. Child.* 1983; **58**: 73–4.
- 17 Department of Health. *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom*. Report on Health and Social Subjects No. 41. London: HMSO, 1991.
- 18 Davies DP. Plasma osmolality and feeding practises of healthy infants in the first three months of life. *BMJ* 1973; **2**: 340–2.
- 19 Oski FA, Landaw SA. Inhibition of iron absorption from human milk by baby food. *Am. J. Dis. Child.* 1980; **134**: 459–60.
- 20 Woodruff CW, Wright SW, Wright RP. The role of fresh cows' milk in iron deficiency. *Am. J. Dis. Child.* 1972; **124**: 26–30.
- 21 Fuchs GJ, Farris RP, De Wier M, *et al.* Iron status and intake of older infants fed formula versus cow milk with cereal. *Am. J. Clin. Nutr.* 1993; **58**: 343–8.