childhood diabetes one might expect to see high rates in Africa.

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Relation between early introduction of solid food to infants and their weight and illnesses during the first two years of life

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Abstract

***Objective*—To assess the relations between early introduction of solid food and infant weight, gastrointestinal illness, and allergic illnesses during the first two years of life.**

***Design*—Prospective observational study of infants followed up for 24 months after birth.**

***Setting*—Community setting in Dundee.**

***Patients*—671 newborn infants, of whom 455 were still available for study at 2 years of age.**

***Main outcome measures*—Infants' diet, weight, and incidence of gastrointestinal illness, respiratory illness, napkin dermatitis, and eczema at 2 weeks and 2, 3, 4, 6, 9, 12, 15, 18, 21, and 24 months of age.**

***Results*—The infants given solid food at an early age (at <8 weeks or 8-12 weeks) were heavier than those introduced to solids later (after 12 weeks) at 4, 8, 13, and 26 weeks of age ($p < 0{\cdot}01$) but not at 52 and 104 weeks. At their first solid feed those given solids early were heavier than infants of similar age who had not yet received solids. The incidence of gastrointestinal illness, wheeze, and nappy dermatitis was not related to early introduction of solids. There was a significant but less than twofold increase in respiratory illness at 14-26 weeks of age and persistent cough at 14-26 and 27-39 weeks of age among the infants given solids early. The incidence of eczema was increased in the infants who received solids at 8-12 weeks of age.**

***Conclusion*—Early introduction of solid food to infants is less harmful than was previously reported. Longer follow up is needed, but, meanwhile, a more relaxed approach to early feeding with solids should be considered.**

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Introduction

Successive publications of *Present Day Practice of Infant Feeding* have stated that infants should not be introduced to solid food before the age of 3 months and preferably not before 4 months.[1-3] This view has been supported by European and American paediatric committees.[4,5] The stated reasons for discouraging the premature introduction of solids include the possible risk of excessive weight gain,[7,8] vulnerability of the gut to infection,[9] and increased susceptibility to the development of allergic disease.[10] Despite these warnings many infants receive solids before the recommended time: a survey in 1980 by the Office of Population Censuses and Surveys showed that 56% of infants were introduced to solids before 3 months of age, and the proportion had increased to 62% when the survey was repeated in 1985.[6] The reason for parents ignoring advice on feeding infants is unclear, but it may be that, contrary to professional belief, parents are not witnessing the predicted harmful effects of early feeding with solids and may perceive it to be beneficial to their infant.

Although earlier studies indicated that infants who received solids at an early age were significantly heavier than those who were introduced to solids at the recommended time,[7,8] more recent reports have been unable to confirm this association.[11-13] To determine the independent effect of early feeding with solids on weight, numerous other factors which may influence infant weight (such as maternal height, infant's sex, birth weight, weight on starting solids, type of milk feed, and health) must be considered. To date no studies of the effect of early feeding with solids on weight have made adjustments for relevant factors.

Although the early introduction of solids to infants in Third World countries has been shown to place them at increased risk of gastrointestinal infection,[9] there are no data to support or refute this claim for infants in developed countries. Studies on infant feeding and allergic disease have concentrated on the effect of breast milk and artificial formulas,[14] and there are few data on the effect of solid food. Recent reports from one centre in New Zealand have shown an increase in the incidence of eczema in children aged 2 and 10 years who had been introduced to solid food before 4 months of age.[15,16] The incidence of asthma was not influenced by early introduction of solids,[17] and other allergic disorders were not considered in these reports.

The aim of this study was to determine whether the early introduction of solid foods had a significant independent effect on infants' weight, gastrointestinal illness, and allergic disorders in the first two years of life after adjustment for potential confounding factors.

Subjects and methods

After giving parents a detailed verbal explanation of the study we recruited 671 infants born after 38-42 weeks' gestation. All mothers were delivered in the single obstetric unit of Ninewells Hospital, were resident in the city of Dundee, and were living in a stable relationship. The parents were informed of local guidelines for feeding infants and young children, which encourage breast feeding and recommend delaying the introduction of solids until 3 months of age.

INFANT FEEDING

Home visits by a health visitor were planned for each mother at 0·5, 1, 2, 3, 4, 6, 9, 12, 15, 18, 21, and 24 months after the birth. At each visit the health visitor used a standardised questionnaire to record details of the infant's feeding in the previous 24 hours: number of breast feeds, number and types of formula bottle feeds, number of juice and water feeds, and number of solid feeds. The dates of the first formula feed, first cow's milk feed, first solid feed, and last breast feed were also recorded when appropriate. Supplementary feeding was defined as the introduction of formula feeds, cow's milk, or solid feeds but not the use of juice or water.

The mothers were given cards to record the feeding and any illnesses of their infants to improve accuracy of recall. On the basis of this record of feeding the mothers were allocated to one of four milk feeding groups: exclusive breast feeding (mothers who breast fed for ≥ 13 weeks and did not introduce supplements before that time), partial breast feeding (mothers who breast fed for ≥ 13 weeks and introduced supplements before that time), early weaners (mothers who started breast feeding but discontinued before 13 weeks), and bottle feeders (mothers who bottle fed from birth). Bottle feeders were further divided according to the initial milk formula given and subsequent changes of formula. The timing of the first solid food was recorded, and infants were allocated to one of three groups: solids introduced before 8 weeks of age, solids introduced at 8-12 weeks of age, and solids introduced after 12 weeks of age.

INFANT WEIGHT AND HEALTH

Infant weight was recorded at 4, 8, 13, 26, 52, and 104 weeks of age. The weights were recorded on scales with 20 g divisions (Marsden Weighing Machines, London), which were routinely checked every three months. A standardised data sheet was used to collect information on all episodes of infant illness. Definitions for each illness were derived from those of Chandra[18] and have been previously reported.[19]

Gastrointestinal illness was defined as vomiting or diarrhoea, or both, occurring as a discrete illness and lasting for ≥ 48 hours. This was differentiated from persistent posseting or episodes of regurgitation, which were coded separately. Diarrhoea was diagnosed if stools were reported to be frequent and unformed (more frequent and less formed than usual in breast fed infants) for ≥ 48 hours. These episodes were distinguished from chronic diarrhoeal disease such as cow's milk intolerance and other causes of malabsorption, which was coded separately. Respiratory illness lasting ≥ 48 hours was coded under the predominant symptom—coryza, cough, or wheeze. The diagnosis of eczema was based on the presence of the typical itchy papulovesicular rash, and nappy dermatitis was coded separately.

The health visitors participating in the study were given spoken and written guidance on the definitions of illnesses at two meetings arranged for this purpose. If there was uncertainty about whether an episode of disease fulfilled the agreed definition one of us (JSF) would decide without knowledge of the infant's diet. For each episode of illness the health visitors were asked to record whether a general practitioner was consulted, whether our diagnosis was confirmed, and whether any treatment was given. Hospital admissions were also recorded, and diagnoses were checked against the hospital case records. At the end of follow up general practitioners' records of the infants were scrutinised to supplement the health visitors' data on illnesses, and previously unrecorded episodes were added to our records.

We also recorded factors that we thought might affect the infants' health and growth. These were the infants' length of gestation, sex, birth weight, and weight at introduction of solid food; mothers' height, parity, marital status, age at leaving school, and any history of allergic diseases; mothers' and fathers' ages and smoking habits; and fathers' social class.

DATA ANALYSIS

The data were transferred to a main frame computer, and the incidence of illness and distribution of risk factors were described with the package SPSS-X. The relation of illness or weight to several explanatory variables was investigated by means of multiple regression analysis. These calculations and tests of significance were performed with the package GLIM.[20]

If a weight was not measured at the scheduled time it was estimated by interpolating from the two nearest dates of measurement, provided that one of the measurements was within a specified period. These limits were 2, 7, 13, 15, and 20 weeks for the infants' ages of 8, 13, 26, 52, and 104 weeks. Exploratory analysis of the relation between weight and age suggested that weight was linearly related to $\log_{10}$ (age + 40 (weeks)), and interpolation was performed using this assumption. With this equation the relation between weight and age for infants not yet taking solid food was determined, and the relative weight ((observed weight/predicted weight)$\times$100) at the first solid feed was calculated.

Only 455 infants were still available for study at 104 weeks of age, of whom only 392 were weighed. The data for these infants were therefore reanalysed to see if the relation between feeding patterns and weight and illness at earlier times differed from that of the infants who were not followed up to 104 weeks.

Results

Of the 671 infants recruited to the study, 584 were weighed at 8 weeks of age, 576 at 13 weeks, 544 at 26 weeks, 548 at 52 weeks, and 392 at 104 weeks. Records of illnesses were available for 665 infants at 13 weeks of age, 657 at 26 weeks, 650 at 39 weeks, 634 at 52 weeks, and 455 at 104 weeks.

Altogether 65 of the infants were introduced to solid food at <8 weeks of age, and 332 were started on solids at 8-12 weeks. After their introduction the number of solid feeds per day gradually increased except for a few cases ($<1\%$) when there was a delay before further solids were offered. Table I shows that solids were introduced earlier to infants who were boys, whose birth weight was ≥ 4000 g, and who were from lower social classes. Early solid feeding was also more common in bottle fed infants, but even among those who were partially breast fed 65% received solids before 13 weeks of age.

Table II shows the associations of various factors with infants' weights. Mother's height, birth weight, and being a boy had significant positive associations with weight at 8, 13, 26, 52, and 104 weeks of age. At 8, 13, and 26 weeks of age breast fed infants were heavier than bottle fed infants, but thereafter there was no significant difference. The early introduction of solids

was independently associated with increased weight at 8, 13, and 26 weeks of age but not thereafter. Mother's parity, parental smoking, father's social class, and gastrointestinal and respiratory illnesses had no independent effect on weight.

Both unadjusted data and data adjusted for the above independent variables showed that infants who were introduced to solid food at early ages (<8 weeks and 8-12 weeks) were heavier than those who were fed later when they were weighed at ages of 4 weeks ($p<0.01$), 8 weeks ($p<0.05$), 13 weeks ($p<0.01$), and 26 weeks ($p<0.01$) (table III). At 52 and 104 weeks of age there were no significant differences between the three groups. There were no significant differences between the weights of infants who received solids when aged <8 weeks and the weights of those who received solids at 8-12 weeks of age. The mean relative weight of infants at the time of their first solid feed was +3·2% for those who were fed at <8 weeks of age, +1·6% for those fed at 8-12 weeks, and −3·0% for those fed at >12 weeks ($p<0.01$, F test).

At the earlier times of weighing the mean weights of the 392 infants who were followed up to 104 weeks of age were similar to the weights of the infants who were not followed up to 104 weeks. The pattern of solid feeding among the infants not followed up to 104 weeks did not differ significantly from that of the infants studied at 104 weeks: of those not followed up, 20 (10%) were given solids at <8 weeks of age, 89 (46%) at 8-12 weeks, and 83 (43%) at >12 weeks; of those studied at 104 weeks, 37 (9%) were given solids at <8 weeks, 188 (48%) at 8-12 weeks, and 167 (43%) at >12 weeks. Multiple regression analysis of the infants followed up to 104 weeks showed that factors which had an independent effect on weight were identical to those identified among infants studied at 8 weeks of age: birth weight, sex, and mother's height at 8, 13, 26, 52, and 104 weeks of age; breast feeding at 8, 13, and 26 weeks; and solid feeding throughout the first 9 months of life.

Table IV shows the episodes of illness among the infants in relation to their age when they were introduced to solid food. Multiple logistic regression analysis revealed a significant positive association between an increased incidence of gastrointestinal illness and younger mothers ($p<0.01$), lower social class ($p<0.001$), and bottle feeding ($p<0.001$). When adjustment was made for these variables the incidence of gastrointestinal illness was not influenced by the early introduction of solid food. The relation between the early introduction of solid food and the development of allergic diseases (lung and skin disorders) was studied after adjustment was made for a maternal history of allergic disease as well as the above variables. The early introduction of solids was associated with an increased incidence of respiratory illness at 14-26 weeks of age and persistent cough at 14-26 weeks and 27-39 weeks. Nappy dermatitis and wheeze were not related to the early introduction of solids. At 53-104 weeks of age there was a significant difference in the prevalence of eczema between the three feeding groups, primarily due to the difference between those introduced to solids at 8-12 weeks and those introduced to solids at >12 weeks.

Among the 455 infants who were followed up for 104 weeks, the age of introduction to solid food was associated with respiratory illness at 14-26 weeks of age ($p<0.05$) and persistent cough at 14-26 weeks ($p=0.2$) and 27-39 weeks ($p=0.06$). These associations were similar to those shown by the infants studied at earlier times except for the larger p values. The infants followed up for 104 weeks also showed a similar relation between taking solid food and eczema to the infants studied earlier, and identical non-significant associations with the other outcomes were found. The pattern of solid feeding among the infants studied at 104 weeks was similar to that of the infants not followed up to 104 weeks: of those studied at 104 weeks, 40 (9%) were given solids at <8 weeks of age, 223 (49%) at 8-12 weeks, and 192 (42%) at >12 weeks; of those not followed up, 25 (12%) were given solids at <8 weeks of age, 108 (51%) at 8-12 weeks, and 77 (37%) at >12 weeks.

TABLE I—*Relation between age at which infants introduced to solid food and various characteristics. Values are numbers (percentages)*

Characteristic	Total No	Age when introduced to solid food (weeks) <8	8-12	>12	
Sex:		65	332	274	
Boy	320	38 (12)	171 (53)	111 (35)	$\chi^2=10.3$*
Girl	351	27 (8)	161 (46)	163 (46)	$p<0.005$
Birth weight (g):					
2500-2999	98	8 (8)	49 (50)	41 (42)	
3000-3499	268	21 (8)	130 (49)	117 (44)	
3500-3999	239	28 (12)	114 (48)	97 (41)	$\chi^2=3.6$*
≥4000	66	8 (12)	39 (59)	19 (29)	$p>0.05$
Milk feeding group:					
Breast fed only	97	0	0	97 (100)	
Partially breast fed	130	7 (5)	78 (60)	45 (35)	
Early weaners	180	19 (11)	98 (54)	63 (35)	$\chi^2=10.96$†
Bottle fed	264	39 (15)	156 (59)	69 (26)	$p<0.05$
Father's social class:					
I or II	191	9 (5)	75 (39)	107 (56)	
III	323	37 (11)	166 (51)	120 (37)	$\chi^2=22.5$*
IV or V	145	17 (12)	83 (57)	45 (31)	$p<0.001$
Unknown	12				

*χ^2 Test for trend. †χ^2 Test excluding infants who were breast fed only, df=4.

Discussion

We attempted to determine the independent effect of early introduction to solid food on infant health during the first two years of life. We studied increased weight gain and increased risk of gastrointestinal illness and allergic disorders, which have been reported to be associated with the early introduction of solids.[7-9 15] Our results suggest that once adjustment has been made for confounding variables these adverse associations become less convincing.

TABLE II—*Regression coefficients (standard error) of infants' weights against age at introduction of solid food, sex, type of milk feeding, birth weight, and mother's height*

Age when weight measured (weeks)	Age when introduced to solid food (weeks) <8 v >12	8-12 v >12	Boy v girl	Milk feeding groups: Breast fed only v bottle fed	Partially breast fed v bottle fed	Early weaning v bottle fed	Birth weight	Mother's height
8 (n=608)	0·111	0·060	0·232	0·245	0·118	−0·181	0·523	0·106
	(0·070)	(0·048)	(0·032)	(0·074)	(0·059)	(0·054)	(0·032)	(0·032)
13 (n=586)	0·160	0·084	0·267	0·242	0·056	−0·105	0·437	0·130
	(0·075)	(0·051)	(0·034)	(0·079)	(0·063)	(0·057)	(0·034)	(0·034)
26 (n=545)	0·176	0·092	0·278	0·122	0·003	−0·029	0·335	0·139
	(0·086)	(0·058)	(0·038)	(0·088)	(0·069)	(0·064)	(0·037)	(0·037)
52 (n=480)	0·117	0·060	0·289	−0·050	−0·006	0·006	0·273	0·188
	(0·092)	(0·063)	(0·041)	(0·097)	(0·076)	(0·070)	(0·042)	(0·042)
104 (n=392)	0·009	0·066	0·168	−0·014	−0·056	0·067	0·230	0·175
	(0·113)	(0·077)	(0·050)	(0·113)	(0·091)	(0·084)	(0·049)	(0·051)

Quantitative variables expressed in standardised units (mean 0, SD 1) so coefficients for birth weight and mother's height represent partial correlations. For other factors figure represents difference between specified categories in standardised weights.

TABLE III—*Mean (95% confidence intervals) weights (kg) of infants in relation to their age when introduced to solid food*

Age when weight measured (weeks)	Age when introduced to solid food (weeks)			p Values
	<8	8-12	>12	
4 (n=671)	4·273 (4·184 to 4·361)	4·234 (4·192 to 4·275)	4·139 (4·094 to 4·184)	0·001
8 (n=584)	5·110 (4·996 to 5·223)	5·087 (5·036 to 5·138)	4·960 (4·905 to 5·015)	0·003
13 (n=576)	6·051 (5·911 to 6·190)	5·972 (5·895 to 6·035)	5·779 (5·712 to 5·845)	0·006
26 (n=544)	7·781 (7·580 to 7·983)	7·692 (7·602 to 7·782)	7·418 (7·322 to 7·514)	0·009
52 (n=548)	10·007 (9·742 to 10·271)	9·900 (9·777 to 10·024)	9·961 (9·559 to 9·822)	0·3
104 (n=392)	12·550 (12·130 to 12·982)	12·644 (12·455 to 12·833)	12·520 (12·320 to 12·720)	0·7

Weights adjusted for variables (see text).

TABLE IV—*Numbers (percentages†) of infants with one or more episodes of gastrointestinal illness or skin or respiratory disorders in relation to age when introduced to solid food*

Age at time of illness (weeks)	Age when introduced to solid food (weeks)			χ^2 Test for percentages (df=2)
	<8	8-12	>12	
Gastrointestinal illness:				
0-13	8 (5·7)	53 (9·1)	30 (10·4)	2·33
14-26	15 (20·7)	54 (15·8)	30 (12·9)	2·19
27-39	10 (13·1)	60 (15·9)	50 (23·2)	5·05
40-52	9 (12·2)	56 (15·6)	40 (18·7)	1·66
53-104	17 (41·6)	116 (50·9)	79 (42·6)	2·70
Respiratory illness:‡				
0-13	27 (36·1)	101 (29·1)	83 (33·9)	1·9
14-26	35 (52·0)	153 (46·9)	96 (36·6)	6·3*
27-39	34 (54·1)	158 (47·8)	107 (42·4)	2·6
40-52	31 (50·0)	156 (48·6)	112 (44·7)	0·8
53-104	33 (82·0)	194 (86·0)	149 (78·9)	2·7
Persistent cough:				
0-13	8 (10·7)	28 (8·0)	26 (10·7)	1·3
14-26	16 (23·3)	57 (17·5)	30 (11·7)	5·96*
27-39	19 (29·2)	58 (16·8)	30 (13·2)	7·36*
40–52	9 (12·8)	66 (19·4)	37 (16·7)	1.87
53-104	18 (43·2)	102 (44·4)	68 (36·8)	2·1
Wheeze:				
0-13	1 (1·0)	6 (1·4)	4 (2·2)	0·72
14-26	3 (3·6)	16 (4·2)	10 (4·9)	0·23
27-39	3 (4·2)	21 (5·8)	9 (4·5)	0·54
40-52	2 (2·6)	16 (4·4)	9 (4·4)	0·56
53-104	3 (6·5)	32 (14·5)	18 (9·4)	2·10
Nappy dermatitis:				
0-13	8 (10·7)	68 (19·5)	42 (17·2)	3·38
14-26	11 (15·6)	61 (18·2)	26 (10·7)	5·05
27-39	9 (13·8)	42 (11·9)	23 (10·3)	0·61
40-52	4 (5·9)	42 (12·3)	22 (9·9)	2·76
53-104	4 (10·6)	39 (17·5)	39 (20·2)	1·91
Eczema:				
0-13	1 (1·2)	12 (3·5)	8 (3·2)	0·72
14-26	3 (4·0)	19 (5·2)	9 (4·2)	0·37
27-39	1 (1·8)	18 (5·6)	15 (5·6)	1·80
40-52	1 (1·7)	19 (6·6)	10 (3·1)	4·30
53-104	2 (5·4)	36 (17·0)	18 (8·3)	7·50*

*$p<0.05$.
†Adjusted for maternal age, social class, type of milk feed, and maternal history of allergic disease (see text).
‡Persistent cough, wheeze, and coryza.

We found that infants given solid food at an early age were significantly heavier at 4, 8, 13, and 26 weeks of age but not at 52 or 104 weeks. This difference in weight (about 200-300 g) was evident at 4 weeks of age, before nearly all of those given solid food at an early age received their first solids. This suggests that the relation between being given solid food and weight was probably due to solid food being introduced earlier to heavier infants rather than feeding with solids having an independent direct effect on weight. This was supported by analysis of relative weight, which showed that the infants who were fed solids at an early age were significantly heavier at the time of their first solid feed than were infants of similar age who had not yet received solids. The gradual loss of this difference in weight during the first year of life suggests that, if solids did have a direct effect on infant weight, it was small and short lived. In support, a recent study has shown that an infant's intake of energy is not significantly altered by the introduction of solid food, as the infant seems to reduce the volume of milk consumed.[21] Indeed, the early introduction of solid food may reduce the risk of obesity: a recent report showed that adiposity at 6 years of age was associated with late introduction of solids and prolonged breast feeding.[13]

The incidence of gastrointestinal illness was not related to the age of starting solid food with or without adjustment for the confounding variables of maternal age, social class, and type of milk feed. This suggests that, although there may be theoretical reasons for infants not being able to tolerate solids in the first few months of life,[22] in practice there is no significant gastrointestinal upset. The incidence of chronic diarrhoea in our cohort was too small for proper analysis but there was no difference between the infants given solids when aged less than 8 weeks and those introduced to solids at more than 12 weeks of age. In Third World countries infants receiving solids at an early age have an increased risk of gastrointestinal infection, thought to be related to inadequate sanitation, impaired nutritional status, and poor quality solid foods.[9] These conditions do not apply to most infants in a developed society. In our previous report on this cohort,[19] breast feeding for at least 13 weeks resulted in a significant reduction in episodes of gastrointestinal illness during the first year of life. This low incidence of gastrointestinal illness was seen in both the exclusively breast fed and the partially breast fed groups of infants, 65% of the second group having received solids before 13 weeks of age. The data from our two reports support the view that early introduction of solids does not increase the risk of gastrointestinal illness in infants, and continuation of breast feeding is the vital protective factor against gastrointestinal infection.

The incidence of respiratory illness among infants aged 14-26 weeks was increased by early introduction to solids. Respiratory illness included the symptoms coryza, wheeze, and persistent cough. Analysis of the last two, more serious, symptoms showed that wheeze was not influenced by the early introduction of solids, but there was a 12-16% increase in the incidence of persistent cough during the study periods of 14-26 and 27-39 weeks among the infants introduced to solids at under 8 weeks of age compared with those introduced to solids at over 12 weeks of age. The consistency of this association in two consecutive study periods lessens the possibility that the result is simply a consequence of multiple testing. The association also persisted after we had adjusted for parental smoking and poor social conditions, factors that are associated with respiratory illness in early childhood.[23,24] Whether the respiratory symptoms were a consequence of an atopic reaction or were due to recurrent infection cannot be answered by this study. An atopic element may eventually become more apparent, and a longer follow up would be required to clarify this and to establish whether the respiratory symptoms attain greater clinical significance in later childhood. Fergusson *et al* did not find a significant relation between early feeding with solids and the development of childhood asthma when they followed up children to 4 years of age.[17]

There was an inconsistent relation between early feeding with solids and the incidence of eczema. Surprisingly we found that eczema was most common among infants introduced to solids at 8-12 weeks of age rather than those given solids at an earlier age. Theoretically this could be explained by work on animals, which has shown that hypersensitivity reactions precipitated by large antigenic loads are less extensive than hypersensitivity reactions precipitated by small antigenic stimuli.[25] In newborn infants there is a gradual decrease in intestinal permeability during the first weeks of life,[22] so that the antigenic load capable of being transported across the intestinal wall is less in infants aged 8-12 weeks than in younger infants. Differences between the effects of very early and early

introduction of solids cannot be elicited from the data of Fergusson *et al* because they defined early feeding with solids as before 4 months of age, and details of feeding patterns in this time are not available.[15 16] Continued follow up of our cohort may clarify this issue as the prevalence of eczema and other allergic disorders peaks in later childhood.[26] Fergusson *et al* have now followed up their study group for 10 years[16] and confirmed their earlier report, which associated early feeding with solids and eczema.[15]

This study has shown that, after data were adjusted for confounding variables, early feeding with solids is less harmful to the infant than previously indicated. Apart from a less than twofold increase in respiratory illness no other consistent adverse effects were detected during the first two years of life. Longer follow up is required, but, in the meantime, a more flexible approach to the introduction of solids should be considered, with advice being focused on the specific needs of individual mothers and infants.

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How frequently should basic cardiopulmonary resuscitation training be repeated to maintain adequate skills?

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Adequate skills in cardiopulmonary resuscitation can be achieved and maintained almost entirely by training with manikins.[1] Such skills tend to deteriorate with time and are presently maintained at considerable cost and effort.[2] It would therefore be useful to determine the minimum frequency of training sessions necessary to maintain adequate skills. We are not aware of any systematic study of the decline of basic skills in resuscitation with time and assessed the optimal interval between reinstructions. The aim of this study was to assess how different intervals between reinstructions affect the maintenance of basic skills.

Subjects, methods, and results

A group of 180 nurses from general non-cardiac wards of a teaching hospital were invited to participate and the 141 who agreed were randomly assigned to being given reinstruction at intervals of three (group A), six (group B), or 12 months (group C). At the first training session the participants were asked to perform a resuscitation attempt alone on a manikin (Laerdal Recording ResusciAnne) for two minutes. For the last 30 seconds of the attempt essential variables were recorded. These were compression rate, compression: relaxation ratio, impression, depth, ventilation volume, and breathing interval. Correct placement of the hands was judged visually. The participants were then given instruction in cardiopulmonary resuscitation according to the standards of the Dutch Heart Foundation. Immediately afterwards they were asked to perform another resuscitation attempt for two minutes, which was scored as before, and the results were used as the reference score. Thereafter the participants were asked to return every three, six, or 12 months to perform a resuscitation attempt as described above and to attend a refresher course. The overall quality of the resuscitation attempts was assessed with a scoring system, in which penalty points were assigned for aberrations from the normal values of the variables which characterise resuscitation skills according to the guidelines of the American Heart Association.[3]

Of the 96 nurses who completed the 12 months' study and could be analysed, 27 belonged to group A, 35 to group B, and 34 to group C. The nurses (11 men and 85 women) had a mean age of 28·7 (SD 7·1) years. They had worked in health care for 7·2 (6·1) years and in that time had attended 3·3 (6·9) resuscitation attempts. All the participants had received instruction in cardiopulmonary resuscitation before the study, their most recent training having been 33 (24) months previously.

The reference scores achieved by the three groups after completing the first instruction session were not significantly different (Kruskal-Wallis test), indicating that their baseline skills were similar (figure). All the groups amassed significantly higher numbers of penalty points just before their second reinstruction compared with their reference scores (Wilcoxon's rank sum test), indicating a decline in skills. After reinstruction, however, skills improved and were maintained during subsequent testing of groups A and B. The distribution of scores within every groups was consistent over time (Friedman's test). No correlation was