Annex to draft report: *'Feeding in the First Year of Life'*

Contents

Chapter 2. Policy background: annex tables

Table 2.1: UK recommendations for breastfeeding and the introduction of complementary feeding into the diet of an infant

Category of Recommendations	**Present Day Practice in Infant Feeding: Report of a Working Party of the Panel on Child Nutrition, Committee on Medical Aspects of Food Policy 1974**	**Present Day Practice in Infant Feeding: Report of a working Party of the Panel on Child Nutrition, Committee on Medical Aspects of Food Policy 1980**	**Present day practice in Infant Feeding: Third Report of a Working Party of the Panel on Child Nutrition, Committee on Medical Aspects of Food Policy 1988**	**Weaning and The Weaning Diet: Report of the Working Group on the Weaning Diet of the Committee on Medical Aspects of Food Policy 1994**
Breastfeeding	Breastfeeding for a minimum of 2 weeks and preferably for the first four to six months of life.	The Working Party endorses the recommendation published in the 1974 report, that breastfeeding should be encouraged for the first months of life.	Reaffirms what the 1980 report stated, that the Government Health Departments should encourage all healthy mothers to breastfeed their babies.	Mothers should be encouraged and supported in breastfeeding for at least four months and may choose to continue to breastfeed as the weaning diet becomes increasingly varied.
Introduction of complementary feeding	Early introduction of cereals or other solid foods to the diet before about four months of age should be strongly discouraged. Cereal foods in any form should not be added to the milk in bottle feeds.	The age at which the infant should be offered solid foods varies. The majority of infants should be offered a mixed diet no later than six months, while very few will require solid foods before the age of three months.	The majority of infants should be offered a mixed diet not later than the age of six months Breastfeeding or feeding with infant formula can, with advantage, be continued to at least the end of the first year as part of a mixed diet.	The majority of infants should not be given solid foods before the age of four months and a mixed diet should be offered by the age of six months.
Recommended/common first complementary foods to be introduced to the infant's diet	Cereal powders and rusks made from wheat flour are the most common first solid foods introduced to the infant's diet. These are often sweetened and may be fortified with vitamins and minerals.	The most common first solid foods introduced to the infant's diet are wheat based cereal foods.	The Office of Population Censuses and Surveys reported that the first foods used during weaning were rusks, cereals and commercial baby foods.	An adequate intake of protein with a proper balance of essential amino acids should be ensured during weaning. Infants being weaned on diets restricted in animal protein (e.g. a vegetarian diet) should particularly be offered a variety of foods at each meal. The Working Group recommends non-wheat cereals, fruit, vegetables and potatoes as suitable first weaning foods.
Mode of feeding	—	—	—	Semi-solid foods should be given from a spoon and should not be mixed with milk or other drink in a bottle. From six months of ages, infants should be introduced to drinking from a cup and from age one year onwards, drinking from a bottle should be discouraged.

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Progression of complementary feeding	—	—	—	Food consistency should progress from pureed through minced/mashed to finely chopped. By the age of one year the diet should be mixed and varied.
Allergens	The use of wheat cereal at an early age (before four to six months) is to be discouraged.	In relation to developing gluten enteropathy, for the majority of infants there is no evidence that wheat-based cereals are a food hazard.	For the majority of infants wheat-based cereal foods present no hazard of inducing coeliac disease. Those at risk of developing coeliac disease cannot be identified in advance.	Where there is a family history of atrophy or gluten enteropathy, mothers should be encouraged to breast feed for six months or longer. Weaning before six months should be discouraged. The introduction of foods traditionally regarded as allergenic should be delayed until six months at the earliest.
Vitamin supplementation	Vitamin supplementation should be made available to children during at least the first year of life. A single dose of the vitamin supplement, made available by the UK Government, contains the recommended daily intake of three vitamins (vitamin A, C & D). Breastfed babies should receive three drops daily from the first month, increasing slowly to serval drops daily at four months. Bottle fed babies should receive two drops daily from the first month and increase to four drops daily at four months. When breast or bottle feeding stops, all infants should receive seven drops daily.	Vitamin supplements should be advised for all expectant and lactating mothers and to infants and young children up to the age of five years. The Working Party recommends altering the dosage of the vitamins for infants to a standard dose of five drops from the age of one month until at least two years and preferably five years.	Vitamin supplementation should be given to infants and young children aged from six months up to at least two years and preferably five years. The Working Party endorses the dosage recommended in the 1980 report.	Breastfed infants under six months do not need vitamin supplementation provided the mother had an adequate vitamin status during pregnancy. From age six months, infants receiving breast milk as their main drink should be given supplements of vitamins A and D. Infants fed on manufactured milks do not need vitamin supplements provided their consumption of infant formula/follow on milk is more than 500 mls per day. If they are consuming these milks in smaller amounts or are being given cows' milk, vitamins A & D should be given.
Addition of sugar/salt to complementary foods	Sugar or salt should not be added to the solid foods in an infant's diet.	Sugar or salt should not be added to the solid foods in an infant's diet.	—	Salt should not be added and additional sugars should be limited to that needed for palatability of sour fruits.

An infant is a child who has not attained the age of one year

A young child is a child aged from one to three years

Weaning is the process of expanding the diet to include foods and drinks other thank breast milk or infant formula

Table 2.2: World Health Organization (WHO) recommendations for breastfeeding and the introduction of complementary feeding into the diet of an infant

Category of Recommendations	Joint WHO/UNICEF Meeting on Infant and Young Child Feeding 1979	Feeding and Nutrition of Infants and Young Children, guidelines for the WHO European Region, with emphasis on the former Soviet countries 2003	Guiding principles for complementary feeding of the breastfed child 2003	Guiding principles for feeding non-breast fed children 6-24 months of age 2004	Essential Nutrition Actions, Improving maternal, newborn, infant and young child health and nutrition 2013
Breastfeeding	For optimal breastfeeding the use of supplementary bottle feeding (water and formula) should be avoided. Fully breastfed babies should not need to be introduced to complementary foods before four to six months of age.	All infants should be exclusively breastfed from birth to about six months (26 weeks) of age and at least for the first four months of life. Breastfeeding should preferably continue beyond the first year of life.	Exclusive breastfeeding from birth to six months of age.	Exclusive breastfeeding for the first six months of life. However it is recognised that this may not be possible for all infants.	Exclusive breastfeeding for the first six months of life.
Introduction of complementary feeding	Complementary foods will need to be introduced between four and six months of age.	Complementary foods should be introduced at about six months of age. Some infants may need complementary foods before this time, but they should not be before four months of age.	Introduction of complementary foods at six months of age, with small amounts of food, while maintaining frequent breastfeeding.	Introduction of complementary foods at six months of age with continued breastfeeding up to two year or beyond.	After six months of age infants should receive nutritionally adequate and safe complementary foods while breastfeeding for up to two years of age or beyond.
Recommended/common first complementary foods to be introduced to the infant's diet	Foods that are locally available in the home can be made suitable for weaning.	Infants should be fed a wide variety of foods of high nutritional value. First foods offered should be single-ingredient, pureed foods with a smooth consistency. Examples include pureed home-cooked rice, mashed potato and pureed fruit or vegetables.	Feed a variety of foods to ensure nutrient needs are met. Meat, poultry, fish or eggs should be eaten daily or as often as possible.	Infants can eat pureed, mashed and semi-solid foods beginning at six months of age.	Small amounts of a variety of foods to ensure nutrients needs are met and increase quantity as the child gets older.
Mode of feeding	During weaning, infants should be fed by cup and spoon or other suitable utensils.	Infant should become accustomed to eating from a spoon.	—	—	—
Progression of complementary feeding	—	As infants continue to develop, foods of a thicker consistency and lumpier texture may be introduced.	Infants can eat pureed, mashed and semi-solid foods beginning six months. By eight months, most infants can also eat "finger foods".	By age eight months most infants can also eat finger foods. By 12 months of age, most children can eat the same types of foods as consumed by the rest of the family.	—
Allergens	—	—	No restrictions advised.	—	—

Category of Recommendations	Joint WHO/UNICEF Meeting on Infant and Young Child Feeding 1979	Feeding and Nutrition of Infants and Young Children, guidelines for the WHO European Region, with emphasis on the former Soviet countries 2003	Guiding principles for complementary feeding of the breastfed child 2003	Guiding principles for feeding non-breast fed children 6-24 months of age 2004	Essential Nutrition Actions, Improving maternal, newborn, infant and young child health and nutrition 2013
Vitamin supplementation	—	Vitamin supplementation can differ between countries.	Use fortified complementary foods or vitamin-mineral supplements for the infant, as needed.	Vitamin supplements that contain iron and the use of fortified foods should be taken as needed. If adequate amounts of animal-source foods are not consumed, fortified foods or supplements should contain other nutrients, such as zinc, calcium and vitamin B12.	Use fortified complementary foods or vitamin-mineral supplements as required.
Addition of sugar/salt to complementary foods	—	Complementary foods should have no added sugar, salt or strong seasoning such as curry powder or chilli pepper.	Avoid giving sugary drinks such as soda.	—	—

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Chapter 4. Infant feeding, growth and health: annex tables

Table 4.1: Gastrointestinal infections

Study reference	**Study design**	**Country/setting**	**Participants** number, gender, age, ethnicity	**Definition of EBF and complementary feeding/weaning**	**Outcome measures**	**Confounders**	**Findings**
Cohen et al, 1994	Randomised intervention study to investigate the effects of age of introduction of complementary foods on infant breast milk intake, total energy intake, and growth. Low-income primiparous mothers who had exclusively breastfed for 4m randomly assigned to one of three groups: continued exclusive breastfeeding to 6 m (EBF); introduction of complementary foods at 4m with ad libitum nursing (SF); introduction of complementary foods at 4m, with maintenance of baseline nursing frequency (SF-M).	Honduras	141 Honduran infants born to low income primiparous mothers. EBF:*n*=50 SF: *n*=47 SF-M: *n*=44	EBF = BF with no other liquids or solids until 6 months. MBF = introduction of complementary solid food at 4m with either ad libitum nursing (SF) or maintenance of baseline nursing frequency (SF-M)	Weight and length gain 4-6 and 6-12m; WAZ, LAZ and WLZ at 6m; % days with fever, cough, nasal congestion, nasal discharge, hoarseness, and diarrhoea; achievement of developmental milestones; maternal postpartum weight loss 4-6m; resumption of menses by 6.		At 4m, no significant differences in breast milk intake between the groups (average 797g/d). Between 4-6m, breast milk intake was unchanged in the EBF group but decreased significantly in the SF and SF-M groups (p<0.001). Change in total energy intake (including solid foods) and infant weight and length did not differ significantly between groups.
Duijts et al, 2010	Study embedded in the Generation R Study, a population-based prospective cohort study from fetal life until young adulthood, to examine the associations of duration of exclusive breastfeeding with infections in the upper respiratory (URTI), lower respiratory (LRTI), and gastrointestinal (GI) tracts in infancy. Rates of breastfeeding during the first 6 months (never; partial for <4 months, not thereafter; partial for 4-6	Rotterdam, The Netherlands	Information about breastfeeding in infancy was available for 4618 infants, of which information about at least 1 infectious disease at the ages of 6 and 12m was available for 4164 and 3962 infants, respectively. For the adjusted analyses, complete information about duration of exclusive breastfeeding, infectious diseases, and all confounders until the age of 6 months was available for 3504 (upper respiratory tract infections), 3489 (lower respiratory tract infections),	Information about breastfeeding was obtained by postal questionnaires when infants were aged 6 and 12 months. Mothers were asked whether they ever breastfed their infants. Duration of breastfeeding was assessed by asking at what age (in months) the infant received breast milk for the last time. 3 categories of breastfeeding were used for 3 groups of infants who received	Information about infectious diseases was obtained with questionnaires given when the infants were aged 6-12m. Parents were asked whether their infant had had a serious cold, ear or throat infection, pneumonia, bronchitis, bronchiolitis, or GI tract infection ("no", "yes, not visited doctor", or "yes, visited a doctor"). No information was available for the number of episodes of these infections. The respiratory tract infections were combined into doctor-	Ethnicity and maternal educational level (defined according to the classification of Statistics Netherlands). Family history of asthma, house dust mite allergy, hay fever (all available from questionnaires). Birth weight and D.O.B obtained from midwife and hospital registries. Gestational age (determined by fetal ultrasound). Information about siblings, day care	Compared with never-breastfed infants, those who were breastfed exclusively until the age of 4 months and partially thereafter had lower risks of infections in the URTI, LRTI, and GI until the age of 6 months (adjusted odds ratio [aOR]: 0.65 [95% CI; 0.51-0.83]; aOR:0.50[CI:0.32-0.79]; and aOR;0.41[CI:0.26-0.64]. respectively) and of LRTI infections between the ages 7-12 months (aOR;0.46[CI:0.31-0.69]). Similar tendencies were observed for infants who were exclusively breastfed for 6m or longer. Partial breastfeeding, even for 6m, did not result in significantly lower risks of these infections.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
	months; exclusive for 4 months, not thereafter; exclusive for 4 months, partial thereafter; and exclusive for 6 months) and doctor-attended infections in the URTI, LRTI and GI until the age of 12 months were assessed by questionnaires. Participating children were born between April 2002 and January 2006		and 3438 (gastrointestinal infections) infants. For the age period 7-12m, complete information on breastfeeding and infectious diseases was available for 2958 (upper respiratory tract infections), 3027 (lower respiratory tract infections) and 2938 (gastrointestinal infections) infants.	breastfeeding for <4m, 4-6m, or 6m or longer. The duration of exclusive breastfeeding was defined by using the information regarding at what age other types of milk and/or solids were introduced during the first 6m of life. The information about duration and exclusiveness of breastfeeding was combined and grouped into the following 6 breastfeeding categories: 1) never; 2) partial for <4m, not thereafter; 3) partial for 4-6m; 4) exclusive for 4m, partial thereafter; and 6) exclusive for 6m. "Never" indicates that the infant had never been breastfed, "partial" indicates that the infant was both breastfeeding and fed formula or solids during this period, and "exclusive" indicates that he infant was breastfed and received no other milk, solids, or fluids. After 6m, all infants received other milk, fluids and/or solids.	attended and not doctor-attended upper (serious cold, ear infection, throat infection) and lower (pneumonia, bronchitis, broncholitis) respiratory tract infections.	attendance, and maternal smoking (yes/no) obtained by questionnaire when the infants were 6m.	

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
Fisk et al, 2011	Study embedded in the Southampton Women's Survey (SWS), a prospective birth cohort study, assessing the relationship between the duration of breastfeeding (including mixed feeding) and the prevalence of lower respiratory tract infections, ear infections and gastrointestinal morbidity during the first year of life. Infants followed up at 6 and 12m of age. Information on age at which solids were first regularly introduced was collected at 6 m. At 12m, mothers asked how many months she had been back at work. A detailed history of milk feeding (human milk, formulas and other milks) was obtained at 6 and 12m.	UK	1764 infants born to Southampton Women's Survey (SWS) participants.	Breastfeeding duration was defined according to the date of last breastfeed and therefore included all types of breastfeeding, including mixed feeding (breast milk alongside infant formula and other foods and drinks).	Questions were asked at 6 and 12m regarding whether the infant had suffered from any of the following over the previous 6m: diarrhoea lasting 2 or more days, one or more bouts of vomiting lasting 2 or more days, one or more episodes of chest wheezing/whistling or woken at night coughing 3 or more nights in a row (prolonged cough). Also, whether the infant had been diagnosed by a doctor as having a chest infection, bronchitis, bronchiolitis, pneumonia or an ear infection over the previous 6m.	On enrolment to the survey, data was obtained on the women's BMI (measured), maternal age, whether the mother lived with a partner, educational attainment, Index of Multiple Deprivation, social class, number of children the woman had. Women who became pregnant were followed up and asked during pregnancy whether they were currently smoking and whether they or the father had ever suffered from asthma. Birth weight, gestational age and sex of infant were recorded at birth. After variables were entered in a multiple regression model, maternal age, smoking in pregnancy, educational attainment, BMI, months that mother had been back at work and age at which solids were first regularly introduced were all independently associated with breastfeeding duration. These 6 variables were considered potential confounders and were entered as covariates in subsequent analyses.	81% infants were breastfed initially, and 25% were breastfed up to 6m. There were graded decreases in the prevalence of respiratory and gastrointestinal symptoms between 0-6m as breastfeeding duration increased; these were robust to adjustment for confounding factors. The adjusted relative risks (95% CI) for infants breastfed for 6 or more months compared with infants who were never breastfed were 0.72 (0.58-0.89), 0.43 (0.30-0.61) and 0.60 (0.39-0.92). for general respiratory morbidity, diarrhoea and vomiting, respectively. Duration of breastfeeding in the 2nd half of infancy was less strongly related to diagnosed respiratory tract infections and gastrointestinal morbidity, although important benefits of breastfeeding were still seen.

Study reference	**Study design**	**Country/setting**	**Participants** number, gender, age, ethnicity	**Definition of EBF and complementary feeding/weaning**	**Outcome measures**	**Confounders**	**Findings**
Howie et al, 1990	A prospective observational study of mothers and babies followed up for 2 years to assess the associations between infant feeding and illness, in particular gastrointestinal disease. Detailed information on infant feeding (inc. number of breastfeeds/d, number and types of formula feeds/d, number of solid feeds/d, age at introduction of supplementary feeds) and illness (inc. gastrointestinal, respiratory, ear infections) was collected by health visitors at planned home visits at 2 weeks and 1,2,3,4,6,9, 12,15,18,21 and 24 months. Mothers were allocated into 1 of 4 groups for comparison purposes: 1) Mothers who breastfed for ≥13 weeks with no supplementary feeding (full breastfeeders); 2) mothers who breastfed for >13 weeks but introduced supplementary feeds during this time (partial breastfeeders); 3) mothers who started breastfeeding but discontinued before 13 weeks (early weaners); 4) mothers who bottle fed from birth (bottle feeders).	UK	750 mother: infant pairs recruited in 3 waves (Sept 1983-Dec 1984; Mar-Aug 1985; Dec 1985-May 1986), of which 76 were excluded because the babies were preterm (<38 weeks), LBW (<2500g), or treated in special care for >48 hours. Of the remaining 674 pairs, 618 were followed up for two years.	Supplementary feeding was defined as the introduction of formula feeds, cows' milk, or solid feeds specifically omitting the use of juice or water.	Information was recorded using a standardised form at each visit on all episodes of infant illness, maternal health, and illness among siblings since the previous visit. Clear definitions were provided for 1) gastrointestinal illness (vomiting or diarrhoea, or both lasting as a discrete illness for 48 hrs or more); 2) respiratory infections (cold accompanied by cough or wheeze, or both, lasting for 48 hours or more); 3) ear infection (painful or discharging ear lasting for 48 hours or more); 4) other infections (infections of mouth, ear, eye and skin lasting 48 hours or more); 5) colic; 6) eczema; 7) nappy rash. For each episode of illness, health visitors recorded whether the disease had been confirmed by doctor diagnosis and/or treatment prescribed. Hospital admissions were also recorded.	Maternal factors (age, parity, social class, height, smoking habit, martial state, age at leaving school, complications in pregnancy, puerperal illness, previous medical illness); infant factors (sex, birth weight, gestational age, mode of delivery, duration of labour, Apgar score, neonatal jaundice, immunisation, illness in siblings, attendance at day care nursery); paternal and social factors (e.g. age, social class, smoking habit)	After adjustment for potential confounders, infants who were breastfed for 13 weeks or more (n=227) had a significantly lower risk of gastrointestinal illness than those who were bottle fed from birth (n=267) in the first 13 weeks of life (p<0.01; 95%CI for reduction in incidence of 6.6% - 16.8%), 14-26 weeks (p=0.01), 27-39 weeks (p<0.05), and 40-52 weeks (p<0.05).

Study reference	**Study design**	**Country/setting**	**Participants** number, gender, age, ethnicity	**Definition of EBF and complementary feeding/weaning**	**Outcome measures**	**Confounders**	**Findings**
Kramer et al, 2000	Cluster-randomised trial of a breastfeeding promotion intervention modelled on the WHO/UNICEF Baby-Friendly Hospital Initiative (BFHI) - PROBIT. 31 hospitals (and affiliated polyclinics) randomised to receive BFHI training of medical, midwifery and nursing staff (experimental group) or to continue their routine practices (control group) to assess the effects of breastfeeding promotion on breastfeeding duration and exclusivity and gastrointestinal and respiratory infection and atopic eczema in infants. Infants followed up at 1, 2,3,6,9, and 12 months.	Republic of Belarus	*n*=17,046 mother-infant dyads consisting of singleton infants, born at >37 weeks gestation, weighing ≥ 2500g at birth and their healthy mothers who intended to breastfeed. 16,491 (96.7%) completed the intervention.	EBF = no liquids or solids other than breast milk for ≥6 m MBF = EBF for 3m with introduction of non-breast milk liquids or solids, or both, by 6m.	Duration of any breastfeeding, prevalence of predominant and exclusive breastfeeding at 3 and 6m; occurrence of and hospitalization for gastrointestinal (GI) and respiratory infection; atopic eczema and recurrent wheezing in first 12m of life, compared between the experimental and control groups.		Infants from the intervention sites were significantly more likely than control infants to be breastfed at 12m (19.7% v 11.4%; adjusted odds ratio [OR], 0.47; 95% confidence interval [CI], 0.32-0.69), were more likely to be EBF at 3m (43.3% vs 6.4%; p<0.001) and at 6m (7.9% vs 0.6%, p=0.01), and had a significant reduction in the risk of one or more GI infection (9.1% vs 13.2%; adjusted OR, 0.60; 95% CI, 0.40-0.91) and of atopic eczema (3.3% vs 6.3%; adjusted OR, 0.54; 95% CI, 0.31-0.95), but no significant reduction in respiratory infection (intervention group, 39.2%; control group, 39.4%; adjusted OR, 0.9=87; 95% CI, 0.59-1.28).
Onayade et al, 2004	A comparative prospective study to compare the growth and illness pattern of infants EBF for 6m vs infants introduced to complementary foods <6m.	Nigeria	*n*=352 mother: infant pairs (345 pairs followed up to 6 m of life), where infants weighed ≥2500g. Infants were <14 d old at recruitment.		Mean/median monthly weights in the first 6m of life; history/outpatient presentation of illnesses.		At 6m, 264 (76.5%) were EBF, 45 (13.1%) had started complementary feeding between 4-6m, 36 (10.4%) commenced complementary feeding <4m. Infants EBF for 6m had median weights above the WHO/NCHS reference and the mean weight was above that of infants who started complementary feeding <6m. Infants who were introduced to solids <4m reported more symptoms and had more illness episodes (1.4/child) compared with those introduced to solids between 4-6m (1.2 episodes/child).

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
Paricio-Talayero et al 2005	Prospective cohort study following 1385 infants from birth to 1 yr recruited between 1996-1999 to assess the effect of breastfeeding on the probability of hospitalization as a result of infectious processes during the first year of life.	Spain	Infants recruited from an area of Spain with a middle to upper-middle socioeconomic level and unemployment rate almost half the national average.	Full breastfeeding (FB) is defined as exclusive (no other liquid or solid is given to the infant) or almost exclusive (vitamins, mineral water, juice, or ritualistic feeds are given infrequently in addition to breast feeds) - WHO definition. Duration of breastfeeding was measured in months, with precision of 1 week.	Hospitalization as a result of an episode of infection in the first year of life, excluding infections of perinatal cause but not other infections that occurred within 2 weeks after birth. Kaplan-Meir survival analysis was performed for hospitalizations that were attributable to infection according to 3 periods of breastfeeding: FB for 0 months; FB for <4m; FB for >4m.	Renumerated work and education level of the mother, vaginal or caesarean birth, season in which the child was born, gender, twin status, distance to hospital, family economic status.	A statistically significant inverse relationship was observed between FB according to month and hospitalization for infections. FB at discharge after delivery and at 3, 4, and 6 months of age were 85%, 52%, 41% and 15%, respectively; 78 hospital admissions as a result of infections were recorded (38 respiratory tract, 16 GIT). Mean age at admission was 4.1m. After estimating the attributable risk, it was found that 30% of hospital admissions would have been avoided for each additional month of full breastfeeding. The authors estimated that 100% FB at 4 months would avoid 56% hospital admissions in infants who are younger than 1yr.
Quigley et al, 2007	Population-based survey (sweep 1 of the UK Millennium Cohort Study). Data on infant feeding, infant health, and a range of confounding variables available on 15,980 healthy, singleton term infants born in 2000-2002. The effects of partial and exclusive current breastfeeding on hospitalization in the same month were estimated.	UK	15,980 term singleton infants who did not have major problems at birth.	Infant feeding was categorized per month into the following groups: 1) not breastfed; 2) partially breastfed (received some breast milk but also received other milk and/or solids); 3) exclusively breastfed (received only breast milk and no other milk, solids, or fluids other than water).	Parental report of hospitalization for diarrhoea and lower respiratory tract infection in the first 8 months after birth. Among the possible reasons for admission listed on the questionnaire were 'gastroenteritis' and 'chest infection or pneumonia'.	Birth weight, gestation, mode of delivery, infant's age in months, infant's gender, maternal age in years, whether the infant was first born, maternal (current) smoking, maternal occupation (coded using the UK National Statistics Socio-economic Class), maternal education, maternal marital status, whether the infant lives in rented accommodation.	77% infants were ever breastfed, 34% received breast milk for at least 4 months, and 1.2% were exclusively breastfed for at least 6 months. By 8 months of age, 12% infants had been hospitalized (1.1% for diarrhea and 3.2% for lower respiratory tract infection). Data analysed by month of age (after adjustment for confounders) found that exclusive breastfeeding vs not breastfeeding protects against hospitalization for diarrhea (adjusted OR: 0.37; 95% CI: 0.18-0.78) and lower respiratory tract infection (adjusted OR: 0.66; 95% CI: 0.47-0.92). The effect of partial breastfeeding is weaker (not statistically significant). Population-attributable fractions suggest that an estimated 53% of diarrhea hospitalizations could have been prevented each month by exclusive breastfeeding and 31% by partial breastfeeding. Similarly, 27% of lower respiratory tract infection hospitalizations could have been prevented each month by exclusive breastfeeding and 25% by partial breastfeeding. The protective effect of breastfeeding for these outcomes wears off

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
							soon after breastfeeding ceases.
Quigley et al, 2009	Using data from the Millenium Cohort Study (MCS), a nationally representative UK longitudinal study, to assess the independent effects of solids and breastfeeding on the risk of hospitalisation for infection in term, singleton infants. Data from each infant were divided into 1 month age bands and analysed for having received solids that month (all data 1-8m included). There monthly risk of hospitalisation was estimated according to whether the infant had received solids in that month (a time-dependent variable), the type of milk they had received in that month (a time-dependent variable), and potential confounders including age. For the analysis of age at introduction of solids, the outcome was the risk of hospitalisation at any time after the introduction of solids - data included from the month of introduction of solids until they were 8m old. The monthly risk of hospitalisation was estimated according to the month at which they started solids (a fixed variable), the type of milk they received in that month (a time	UK	15,980 term singleton infants who did not have major problems at birth.		Hospitalised morbidity was assessed by the reported age and diagnosis at the time of any hospital admissions since birth. Diarrhoea was defined as 'gastroenteritis' (n=201) and LRTI as 'chest infection or pneumonia' (n=552). Breastfeeding duration and introduction of other milk and solids were estimated from interview responses about the age of the infant when last given breast milk, and when first given formula, other types of milk and solids. Infants were categorised separately according to whether they were on solids (yes, no) and the type of milk they were receiving (formula only, breast milk and formula, breast milk only).		At 6m, 25% were still breast fed. The mean age of introduction of solids was 3.8m. For both diarrhoea and LRTI, the monthly risk of hospitalisation was significantly lower in those receiving breastmilk compared with those receiving formula. The monthly risk of hospitalisation was not significantly higher in those who had received solids compared with those not on solids (for diarrhoea, adjusted OR 1.39, 95%CI 0.75 to 2.59; for LRTI adjusted OR 1.14, 95% CI 0.76 to 1.70), and the risk did not vary significantly according to the age of starting solids.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
	dependent variable) and potential confounders including age.						
Sankar *et al*, 2015	Systematic review to compare the effect of predominant, partial or nonbreastfeeding versus EBF on mortality rates from 0-6m of life, and effect of no BF on mortality rates between 6-23m of age.	6 studies from Africa; 2 studies from Latin America; 5 studies from South-East Asia; 1 study from Eastern Mediterranean; 1 study from Western Pacific.	46,499 infants aged <2 years.	WHO definitions used for breastfeeding exposure categories; exclusive, predominant, partial, or non breastfeeding.	All-cause mortality and infection-related mortality at: 0-5m, 6-11m, 12-23m of age. Infection-related mortality included deaths due to any infection including sepsis, meningitis, pneumonia, diarrhoea, measles, malaria.		Risk of all-cause mortality was higher in predominantly (RR 1.5), partially (RR 4.8) and non-breastfed (RR 14.4) infants compared with EBF infants 0-5m. Children aged 6-11m and 12-23m of age who were not breastfed had 1.8 and 2.0 fold higher risk of mortality, respectively, compared with EBF infants. Risk of infection-related mortality in 0-5m was higher in predominantly (RR 1.7), partially (RR 4.56) and non-breastfed (RR 8.66) infants compared with EBF infants. The risk was 2-fold higher in non-breastfed children aged 6-23m.

Table 4.2: Lower respiratory tract infections

Study reference	**Study design**	**Country/setting**	**Participants** number, gender, age, ethnicity	**Definition of EBF and complementary feeding/weaning**	**Outcome measures**	**Confounders**	**Findings**
Bachrach et al 2003	Meta-analysis to examine breastfeeding and the risk of hospitalization for lower respiratory tract disease in healthy full term infants with access to modern medical care. The authors identified 34 relevant research studies, 9 of which met the inclusion criteria. 7 of these studies used cohort study designs allowing summary relative risk ratios to be reported. The study designs of the 2 remaining studies, a cross-sectional analysis and an ecological design, provided odds ratios.	Developed/industrialised nations (USA, Canada, New Zealand, Australia, Scotland, Norway)	Healthy, full-term infants in developed/industrialised nations (high living standards in terms of access to modern medication and sanitation). Limited to studies of populations that excluded sick, premature and/or low birth weight infants. The meta-analysis evaluated the risk of hospitalization in 3,201 breastfed subjects and 1,324 non-breastfed subjects.	Studies included that characterised breastfeeding as exclusive (little or no formula offered) and provided a duration of exclusive breastfeeding for 2, 4 or 6 months or total (any) breastfeeding for longer durations. The breastfeeding inclusion criterion was a minimum exposure of 2 mo exclusive breastfeeding or 9 mo total (any) breastfeeding compared with its absence.	Lower respiratory tract disease (LRTD) hospitalization rates. LRTD included: bronchiolitis, asthma, bronchitis, pneumonia, empyema, infections due to specific agents (e.g. respiratory syncytial virus)	Maternal smoking and SES	Data from all primary material (33 studies) indicated a protective association between breastfeeding and the risk of respiratory disease hospitalization. 9 studies met all inclusion criteria, and 7 cohort studies were pooled. The feeding contrasts in these 7 studies were 4 or more months of exclusive breastfeeding vs no breastfeeding. The summary relative risk (95%CI) was 0.28 (0.14-0.54), using a random-effects model [EBF for 4 or more months appears to decrease the risk of respiratory hospitalization in infancy to one third or less the risk observed for formula fed infants, even in developed countries with high standards of living]. This effect remained stable and statistically significant after adjusting for the effects of smoking or socioeconomic status. Given the methodological quality of the meta-analysis, Ip et al (2007) concluded that breastfeeding for 4 or more months is associated with a reduction in risk of hospitalization secondary to lower respiratory tract diseases.

Table 4.3: Acute otitis media (AOM)

Study reference	**Study design**	**Country/setting**	**Participants** number, gender, age, ethnicity	**Definition of EBF and complementary feeding/weaning**	**Outcome measures**	**Confounders**	**Findings**
Bowatte et al, 2015	Systematic review and meta-analysis to synthesis the evidence on the association between duration and exclusivity of breastfeeding and risk of AOM. Meta-analysis conducted on 4 groups: 1) EBF vs not exclusively or not breastfed during first 6m; 2) ever vs never breastfed; any breastfeeding $\geq$3-4m vs $\leq$3-4m; and more or less breastfeeding.	Europe/North America	Numbers of participants in the studies included ranged from 281-11,349.		Development of AOM defined as: doctor diagnosed AOM, parent or self-reported AOM, or AOM recorded on health-related databases. Studies reporting either current or past disease or recorded healthcare utilisation for AOM.	Day care attendance, presence of siblings, socio-economic status, second-hand smoke exposure, ethnicity	In the pooled analysis, any form of breastfeeding was found to be protective for AOM in the first 2 yrs of life. EBF for the first 6m was associated with the greatest protection (OR0.57 95% CI 0.44, 0.75), followed by 'more vs less' breastfeeding (OR 0.67; 0.59, 0.76) and 'ever vs never' breastfeeding (OR 0.37; 0.56, 0.80).

Chapter 5. Energy requirements: annex tables

Table 5.1: Energy content of tissue deposition of infants[a]

Age interval (months)	Protein gain (g/d)	Fat mass gain (g/d)	Energy deposited in growing tissues (kJ/g)
Boys			
0-3	2.6	19.6	25.1
3-6	2.3	3.9	11.6
6-9	2.3	0.5	6.2
9-12	1.6	1.7	11.4
Girls			
0-3	2.2	19.7	26.2
3-6	1.9	5.8	15.6
6-9	2.0	0.8	7.4
9-12	1.8	1.1	9.8

[a]Butte, 2005

Gross energy equivalents: 1g protein = 23.6kJ (5.65 kcal); 1g fat = 38.7kJ (9.25kcal)

Table 5.2: Estimated Average Requirement (EAR) values for infants 0–12 months of age

Age (months)	Total energy expenditure (kJ/day)			EAR[e]					
	Breast-fed[a]	Breast milk substitute-fed[b]	Feeding mixed or unknown [c,d]	Breast-fed		Breast milk substitute-fed		Feeding mixed or unknown	
				kJ/day	kJ/kg per day	kJ/day	kJ/kg per day	kJ/day	kJ/kg per day
Boys									
1	1099	1425	1242	2030	454	2356	527	2173	486
2	1522	1802	1647	2421	435	2701	486	2546	458
3	1837	2082	1947	2505	393	2750	432	2615	411
4	2081	2300	2181	2321	332	2540	363	2421	346
5	2279	2476	2370	2474	329	2671	356	2565	342
6	2442	2622	2526	2602	328	2782	351	2686	339
7	2585	2750	2663	2661	321	2826	340	2739	330
8	2706	2857	2778	2769	322	2920	339	2841	330
9	2818	2957	2886	2877	323	3016	339	2945	331
10	2919	3047	2982	3016	329	3144	343	3079	336
11	3016	3134	3075	3109	330	3227	343	3168	337
12	3109	3217	3164	3199	332	3307	343	3254	337
Girls									
1	991	1328	1138	1819	434	2156	514	1966	469
2	1355	1653	1487	2165	422	2463	480	2297	448
3	1631	1899	1751	2241	384	2509	430	2361	404
4	1856	2099	1966	2154	336	2397	373	2264	353
5	2042	2265	2144	2288	332	2511	364	2390	346
6	2197	2404	2292	2401	329	2608	357	2496	342
7	2329	2521	2418	2412	316	2604	341	2501	327
8	2450	2629	2533	2525	318	2704	340	2608	328
9	2554	2722	2634	2620	319	2788	339	2700	328
10	2655	2812	2730	2738	323	2895	341	2813	332
11	2748	2895	2819	2825	324	2972	341	2896	332
12	2838	2975	2904	2912	325	3049	341	2978	333

[a] Total Energy Expenditure (TEE) (MJ/day) = 0.388 Weight (kg) – 0.635
[b] TEE (MJ/day) = 0.346 Weight (kg) – 0.122
[c] These figures should be applied for infants when the mode and proportions of feeding are uncertain
[d] TEE (MJ/day) = 0.371 Weight (kg) – 0.416
[e] Calculated as TEE + energy deposition (kJ/day) as in Table 5.2

Table 5.3: Weights, growth and energy deposition rates for infants 1–12 months of age

Age (months)	Weight (kg)[a]	Weight velocity (g/day)[b]	Energy deposition (kJ/g)	Energy deposition (kJ/day)
Boys				
1	4.47	37.1	25.1	931
2	5.56	35.8	25.1	899
3	6.37	26.6	25.1	668
4	7	20.7	11.6	240
5	7.51	16.8	11.6	195
6	7.93	13.8	11.6	160
7	8.3	12.2	6.2	76
8	8.61	10.2	6.2	63
9	8.9	9.5	6.2	59
10	9.16	8.5	11.4	97
11	9.41	8.2	11.4	93
12	9.65	7.9	11.4	90
Girls				
1	4.19	31.6	26.2	828
2	5.13	30.9	26.2	810
3	5.84	23.3	26.2	610
4	6.42	19.1	15.6	298
5	6.9	15.8	15.6	246
6	7.3	13.1	15.6	204
7	7.64	11.2	7.4	83
8	7.95	10.2	7.4	75
9	8.22	8.9	7.4	66
10	8.48	8.5	9.8	83
11	8.72	7.9	9.8	77
12	8.95	7.6	9.8	74

[a] 50th percentile weight for age of the WHO Child Growth Standards (WHO, 2006)
[b] 50th percentile weight increment of the WHO Child Growth Standards (WHO, 2006)

Table 5.4: Energy reference values for infants, children and adolescents in the current report compared with values reported by COMA [a]

Age	Energy reference values (MJ/d)					
	COMA (1991)[a]		SACN 2011		Change (+%)	
	Boys	Girls	Boys	Girls	Boys	Girls
0-3 months	2.3	2.2	2.6 [b]	2.4 [b]	13	9
4-6 months	2.9	2.7	2.7[b]	2.5 [b]	-7	-7
7-9 months	3.4	3.2	2.9[b]	2.7 [b]	-15	-16
10-12 months	3.9	3.6	3.2b	3.0 b	-18	-17

[a] DH, 1991
[b] Using the comparable values for breast milk substitute fed infants (see Table 5.1).

Table 5.6: Sufficiency of milk energy intake

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
Nielsen et al, 2011	Longitudinal, observational field study to measure breast milk intake, energy intake and milk energy content (measured using the Doubly Labelled Water - DLW - method), anthropometry, and breastfeeding practices at around 15 and 25 weeks of age.	Glasgow, Scotland	50 healthy, exclusively breastfeeding mother: infant dyads	WHO definition of exclusive breastfeeding i.e. giving only breast milk with allowance for oral rehydration, and vitamins, minerals, and/or medicines.	Breast milk intake (g/day), infant growth expressed as z-scores relative to WHO Child Growth Standards.	Behavioural measures: infant feeding questionnaire (perceived breastfeeding practices, attitudes to infant feeding and support) and infant behaviour diary. Participants were characterised for sociodemographic factors (Scottish Index of Multiple Deprivation), maternal age, height and BMI.	Mean breast milk intake was 923 g/day (SD: 122g/day) at 15 weeks (*n*=36 EBF) and 999g/day (SD:146g/day) at 25 weeks (*n*=33 EBF). Both values were significantly higher (*p*<0.0001) than reported literature values, 779g/day at 3 to 4 months and 894g/day at 6 months. Breast milk intake increased significantly between the two time points (mean increase: 61g/day [95% confidence interval: 23-99]; *p*=0.003). Infant growth was normal compared with WHO Child Growth Standards, and energy intakes were adequate compared with references for energy requirements. Behavioural data on breastfeeding practices and infant behaviour suggested very small and insignificant changes in feeding frequency from the 1st to the 2nd time point.
Reilly et al, 2005	Systematic review to evaluate evidence on metabolisable energy consumption and pattern of consumption with age in infants in the developed world exclusively breastfed at around the time of introduction of complementary feeding.	Europe, North America Australia, New Zealand	1041 mother: infant pairs (33 studies) reported transfer at 3-4m of age; 99 mother: infant pairs (6 studies) measured transfer at 5m; 72 pairs (5 studies) measured transfer at 6m. Breast milk energy content were based on 77 mother: infant pairs (25 studies).	EBF: mothers providing breast milk as the sole source of nutrients and energy.	Breast milk output, measured by isotopic techniques or by test-weighing the infant. Breast milk energy content estimated by sampling breast milk or by conducting a study of infant energy balance		The weighted mean transfer of breast milk was: 779 (SD40)g/d at 3-4m; 827 (SD39)g/d at 5m; 894 (SD 87)g/d at 6m. 9 longitudinal studies reported no significant increases in milk transfer after 2-4m. The weighted mean metabolisable energy content was 2.6 (SD0.2)kJ/g.

Study reference	**Study design**	**Country/setting**	**Participants** number, gender, age, ethnicity	**Definition of EBF and complementary feeding/weaning**	**Outcome measures**	**Confounders**	**Findings**
Wells et al 2012	A randomised controlled trial to determine whether exclusively breastfed (EBF) infants would consume more breast milk at 6 months than infants receiving breast milk and complementary foods. At 4 months of age, infants were randomly assigned to either continue EBF to 6 months or to continue breastfeeding alongside the introduction of complementary foods. Breast milk intake was measured using stable isotopes, and complementary food intakes were weight over 3 days in the complementary feeding group.	Reykjavik, Iceland	100 infants (50 per group) - singleton birth, gestational age ≥37 weeks, healthy, and exclusively breastfeeding at time of assessment.		Anthropometric outcomes (infant body weight, length and head circumference at 4 and 6 months). BMI calculated and converted to *z*-scores. Mean breast milk intake (g/d) and average daily intake of complementary foods (CF group).	Infant anthropometric measurements, together with data on maternal age and education, parity and mode of delivery.	Mean (±) breast-milk intake in the EBF group was 901±158g/d), which was significantly higher than the WHO reference values of 854±24g/d (p=0.04). The CF group consumed 818±166g breast milk/d, which was not significantly different from the WHO reference values. The EBF group therefore consumed 83g/d more breast milk than did the CF group (p=0.012) and this was equivalent to 56kcal/d. Infants in the CF group obtained 63±52 kcal/d form complementary foods. Estimated total energy intakes were similar (EBF:560±98kcal/d; CF: 571±97kcal/d). Secondary outcomes did not differ significantly between groups.

Chapter 6. Infant feeding, body composition and health: annex tables

Table 6.1: Adiposity outcomes: systematic reviews and meta-analyses

Study reference	Study design	Country/setting and participants	Definition of EBF and/or complementary feeding/weaning	Outcome measures	Findings	Papers included in analysis
Moorcroft et al., 2011	Systematic review of 24 randomized and observational studies (1 RCT, 1 re-analysis of 2 RCTs, 1 case-control study, 21 cohort studies). Data from >34,000 participants analysed. Investigated whether timing of introduction of solid foods (whether BF or not) is associated with obesity in infancy and childhood. Some studies analysed data from the same cohorts (e.g. UK Millenium Cohort Study). Meta-analysis was not possible due to the heterogeneity of the studies.	Developed countries. Full-term healthy infants included only.	Only studies which specifically investigated and included within their measures of exposures the timing or age at which solid foods were introduced were included. Inconsistency in categorising introduction of solid foods across studies. Some studies collected this data retrospectively, relying on recall.	Only studies that tracked and measured obesity in infancy (0-12 mo) and/or childhood (1-18 yrs), were included. Inclusion criteria: outcome of interest must be reported after 6 mo age. Anthropometric measures ranged between studies (weight, length, BMI, ponderal index, skin-fold measures, fat mass, lean mass and DEXA) and were measured and reported at different ages.	No clear association between the age of introduction of solid foods and obesity in infancy and childhood was found.	1 RCT: Mehta et al., 1998. 1 re-analysis of 2 RCTs: Morgan et al., 2004. 21 cohort studies: Poskit & Cole 1978; Kramer et al., 1985a,b; Zive et al., 1992; Forsyth et al., 1993; Heinig et al., 1993; Wilson et al., 1998; Haschke et al., 2000; Baker et al., 2004; Lande et al., 2005; Reilly et al., 2005; Burdette et al., 2006; Kuperberg & Evers, 2006; Baird et al., 2008; Sloan et al., 2008; Brophy et al., 2009; Robinson et al., 2009; Griffiths et al., 2009, 2010; Hawkins et al., 2009; Schack-Neilson et al., 2010. 1 case-control study: Kramer, 1981.
Pearce et al, 2013	Systematic review of 23 studies to investigate the relationship between the timing of the introduction of complementary feeding and overweight or obesity during childhood.	Data collected from Australia, Brazil, Canada, China, Denmark, India, Palestine, UK, USA, Europe.	Introduction of complementary feeding defined as the age at which food other than breast milk, water, tea or formula milk was first introduced.	Childhood measures of BMI or percentage body fat at one or more point between 4-12 years. All measurements used to calculate BMI should have been taken by health professionals or trained investigators (not self-reported).	Twenty one studies considered the relationship between the timing of introduction of complementary foods and childhood BMI. 5 studies found that introducing complementary foods <3m (2 studies), 4m (2 studies) or 20 weeks (1 study) was associated with a higher BMI in childhood. Seven studies considered the association between complementary feeding and body composition. Only one study reported an increase in percentage body fat among children given complementary foods before 15 weeks of age. No clear association found between the timing of introduction of complementary foods and childhood overweight and obesity, although some evidence to suggest that introduction at or <4m, rather than 4-6m or ≥6m, may increase the risk of	Agras et al, 1990; Ariza et al,2004 ; Brophy et al, 2009' Burdette et al, 2009; Butte, 2009; Caleyachetty et al, 2013 ; Gooze et al, 2011;Haschke & van't Hof, 2003; Hediger et al, 2001; Kanoa et al, 2011; Kuperberg & Evers,2006 ; Neutzling et al, 2009; Obeidat et al,2010 ; Patterson et al, 1986; Reilly et al, 2005; Robinson et al, 2009; Schack-Nielsen et al, 2010; Seach et al, 2010; Simon et al, 2009; Wilson et al, 1998; Wolman 1984; Zhou et al, 2011; Zive et al, 1992.

Study reference	Study design	Country/setting and participants	Definition of EBF and/or complementary feeding/weaning	Outcome measures	Findings	Papers included in analysis
					childhood obesity.	
Pearce and Langley-Evans, 2013	Systematic review of 10 studies to investigate the relationship between the types of food consumed by infants during the complementary feeding period and overweight or obesity during childhood. Studies were categorised into three groups: 1) macronutrient intake; 2) food type/group; and 3) adherence to dietary guidelines. Quality of the data assessed using an adapted Newcastle-Ottawa scale.	Data collected from Brazil, Denmark, Germany, Iceland, Palestine, UK.	Introduction of complementary feeding defined as the age at which food other than breast milk, water, tea or formula milk was first introduced.	Childhood measures of BMI or percentage body fat at one or more point between 4-12 years. All measurements used to calculate BMI should have been taken by health professionals or trained investigators (not self-reported).	Some association was found between high protein intakes at 2-12 m of age and higher BMI or body fatness in childhood, but this was not the case in all studies. Higher energy intake during complementary feeding was associated with higher BMI in childhood. Adherence to dietary guidelines during the complementary feeding period was associated with a higher lean mass, however, intakes of specific foods or food groups made no difference to children's BMI.	Gunnasdottir & Thorsdottir, 2003; Gunther et al,2007a ; Gunther et al, 2007b; Hoppe et al,2004; Ong et al, 2006; Kanoa et al,2011 ; Santos et al, 2006; Schack-Nielsen et al,2010; Simon et al, 2009; Robinson et al, 2007.

Table 6.2: Adiposity outcomes: Randomised studies

Study reference	Study design	Country/setting and participants	Definition of EBF and/or complementary feeding/weaning	Outcome measures	Findings
Mehta et al., 1998	Randomised trial to determine whether early introduction of solid foods or (type of foods introduced) affects growth or body composition. Infants recruited before 3mo of age and randomised to receive: 1) commercially prepared solid foods from 3 to 12 months, 2) commercially prepared solid foods from 6 to 12 months, 3) parent's choice of solid foods from 3 to 12 months, or 4) parent's choice of solid foods from 6 to 12 months. Three-day food diaries also completed before each visit at 3, 6, 9 and 12mo.	USA. Healthy term infants (n=165) appropriate for gestational age.	"Early" group = introduced to solids at 3 to 4mo. "Late" group = introduced to solids at 6mo. Infants in all groups were formula fed, but were permitted to consume breast milk before randomisation at 3mo.	Weight, length, head circumference measured at 3, 6, 9 and 12 mo. Body composition (DXA) measured at 3, 6 and 12mo.	Early introduction of solid foods did not alter growth or body composition during the first year of life. No differences between early vs. late introduction groups for total energy intake at any age. Solid foods replaced energy intake from formula.

Table 6.3: Adiposity outcomes: Prospective cohort studies (published since Moorcroft et al. systematic review)

Study reference	Study design	Country/setting and participants	Definition of EBF and/or complementary feeding/weaning	Outcome measures	Findings
Abraham et al, 2012	A longitudinal birth cohort study (Growing Up in Scotland) to investigate the interrelationships between early feeding experiences (breastfeeding, complementary feeding) and 1) eating patterns in the second year of life, and 2) weight status in the fourth year of life.	*n*=5217 Scottish children aged 9-12 months followed to 45-48 months of age	Breastfeeding defined using the question 'Was the child ever breastfed?' and age of starting complementary feeding using the question 'How many months old when the child started solid foods?'	SPSS two-step cluster analysis technique used to define eating patterns. Variables included: variety of fruit intake, variety of vegetable intake, snacking behaviour, intake of energy-dense or low-nutrient foods, meal or snack pattern.	Infant feeding was associated with eating patterns in the second year of life. Children who were ever breastfed compared with never breastfed (adjusted OR=1.48, 95% CI 1.27, 1.73) were more likely to have a positive eating pattern (characterised by children who consumed a high variety of fruit daily, a high variety of vegetables daily and fruit between meals, and had a higher prevalence of eating just a meal with no snacking). Children who started complementary feeding at 4-5 months or 6-10 months compared with 0-3 months (adjusted OR = 1.32, 95% CI 1.09, 1.59 or AOR = 1.50, 95% CI 1.19, 1.89) were also more likely to have a positive eating pattern. Breastfeeding was negatively associated with being overweight or obese in the fourth year of life compared with no breastfeeding (adjusted OR = 0.81, 95% CI 0.81, 1.01). Introduction of complementary feeding at 4-5 months compared with 0-3 months was negatively associated with being overweight or obese (adjusted OR = 0.74, 95% CI 0.57, 0.97).
Fall et al., 2011	Pooled data from five prospective birth cohort studies in low- and middle-income countries. The Guatemala cohort did not collect data about the age of introduction of solid foods. The other studies were observational. The methods used to collect infant feeding data varied between studies.	Low- and middle-income countries (Brazil, India, Philippines and South Africa). Data pooled from 10,912 individuals (9640 when Guatemala not included) aged 15-41 years at follow-up	Age at which complementary foods were introduced categorised into six groups: <3mo, 3-6mo, 6-9mo, 9-12mo, 12-18mo and >18mo.	Depending on the cohort, body composition outcomes in adulthood included: BMI, waist circumference, body fat percentage, triceps and subscapular skinfolds, overweight (BMI ≥25kg/m^2) and obesity (BMI ≥30kg/m^2).	Later introduction of complementary foods was associated with lower adult BMI, waist circumference and percentage body fat, thinner skinfolds and a lower risk of overweight/obesity. These findings were similar after excluding data from the India cohort which had a higher mean age of introduction of solid foods and in which data was missing for 61% of participants. When the analysis was limited to the period up to 6mo postpartum, these associations were attenuated. 'Earlier' introduction of solids was associated with higher child weight at 2yrs; after adjusting for weight at 2yrs, the inverse associations between age of introduction of solids and adult adiposity were no longer

Study reference	Study design	Country/setting and participants	Definition of EBF and/or complementary feeding/weaning	Outcome measures	Findings
					present, suggesting that this could be the mediating factor.
Grote et al., 2011	Based on data from participants enrolled in a double-blind RCT that compared 2 groups of children fed cow's milk formula with either a higher or lower protein content for the first year of life (children were followed until 24mo old). Both randomised formula groups were combined into one group for all analyses, because the researchers did not expect the protein intake of the formula to affect the age of introduction of solid foods. Infants were recruited shortly after birth from birth clinics. At 3, 6 and 9mo parents were asked about the current type of feeding and the week of introduction of solids. Infant food intakes were recorded by prospective 3-day weighed food diaries at monthly intervals from the ages of 1 to 9mo, and additionally at ages 12, 18 and 24mo.	5 European countries (Belgium, Germany, Poland, Italy and Spain). Data from 671 healthy formula-fed infants analysed. Recruited between Oct 2002 and July 2004.	Age at introduction of solid foods categorised into four groups: ≤13 weeks, 14-17 weeks, 18-21 weeks and ≥22 weeks.	Anthropometric measurements (length and weight) taken at recruitment (just after birth) and at 3, 6, 12, and 24mo. Weight-for-age, length-for-age, weight-for-length and BMI-for-age z-scores calculated.	Significant differences in growth in the first year of life by age of solid food introduction: children introduced to complementary foods ≤13 weeks were lighter at birth and grew faster between 3 and 6 months of age than the other groups of children. Children introduced to complementary foods ≥22 weeks had a less pronounced growth until 3mo of age and continued on a lower weight percentile than children introduced to solids earlier. However, age of solid food introduction was not found to be associated with any of the anthropometric measurements at 24 mos. Also, solids were found to add additional energy to the diet during the introduction period rather than replacing formula.
Huh et al., 2011	Project Viva prospective birth cohort study. Mothers recruited between 1999-2002, at initial prenatal visit, with a gestational age less than 22 weeks. Researcher visits conducted after delivery, and at 6mo and 3yrs after birth, at which data on infant feeding practices were collected and child length/height and weight measured. Skinfold thickness also measured at 3yrs. At 6mo mothers were asked the timing of the first introduction of each of 10 solid foods or food groups. Response options were "Have not fed this to my child", "<2 months old", "2 or 3 months old", "4 or 5 months old" or "6 months or older". At 6mo (and 1yr) mothers reported breastfeeding status, including the child's age when breastfeeding was stopped.	USA. 847 children, of which 568 (67%) breastfed and 279 (32%) formula fed at 4mo.	Timing of introduction of solid foods defined as child's age at the earliest introduction of any solid food and categorised as <4, 4 to 5, and ≥6 months. Infant feeding status categorised as "breastfed" (children who were at least partly BF for ≥4mo) or "formula fed" (children who were never BF or stopped BF before the age of 4mo).	Obesity at 3 years of age. Age and gender specific BMI percentiles and z scores calculated. Obesity defined as BMI ≥ 95th percentile for age and gender. BMI or less than 85th percentile used as the comparison group. Sum of children's subscapular and triceps skinfold thickness also calculated, as well as change in weight-for-age z score from 0-4mo as a proxy for infant growth before solid food introduction.	Introduction of solids before 4mo (vs. 4-5mo) associated with an increase in obesity (BMI ≥95th percentile) at 3yrs in **formula fed** infants (adjusted OR 6.3, 95% CI 2.3 - 16.9), which was not explained by rapid early growth. Introduction of solids before 4mo also associated with and a 0.36-unit increment in BMI z-scores (95% CI 0.10 - 0.61) at age 3yrs in formula fed infants. Introduction of solid foods after 6mo in formula fed infants was also associated with an increase in the odds of obesity (adjusted OR 3.6) but the CI was wide due to the small number of infants in this group (95% CI 0.8 - 16.3) and was not statistically significant. The timing of solid food introduction was not associated with later obesity risk among the **breastfed** infants. Change in weight-for-age z score (from 0-4mo) larger for FF than BF infants (0.54 vs 0.35 U; p= 0.01). At 3yrs, 7% of BF children were obese vs. 13% FF.

Study reference	Study design	Country/setting and participants	Definition of EBF and/or complementary feeding/weaning	Outcome measures	Findings
Lin et al., 2013	Population-representative Chinese birth cohort of children born in 1997, recruited at the first postnatal visit to a Maternal and Child Health Centre in Hong Kong. Baseline characteristics obtained via a self-administered questionnaire at recruitment. Data on weight and height obtained in 2005 from record linkage (i.e. data from health records collected at Maternal and Child Health centres and annual check-ups of school students). Data on age of introduction of solids obtained via postal survey sent in 2008. Multiple imputation used to predict missing exposure data for the 56.6% of children with BMI z-scores who did not have data on the age of introduction of solid foods.	Hong Kong. "Children of 1997" birth cohort (data analysed from n=7809 at follow-up)	Timing of introduction of solid foods defined as the age when first given solid foods. Categorised as before 3mo, 3-4mo, 5-6mo, 7-8mo and after 8mo.	BMI z-scores at infancy (birth to <2yrs), childhood (2 to <8yrs), and puberty (8 to <14 years). Overweight including obesity (as defined by IOTF cut-offs) also considered as an outcome in childhood and puberty.	No clear association between the age of introduction of solid foods and BMI z-score, overweight (including obesity) in infancy, childhood or puberty. In the available case analysis, introduction of solid foods at <3mo was associated with a higher BMI z-score in childhood and puberty. Introduction of solids at >8mo was also associated with a higher BMI z-score in childhood.
Mihrshahi et al., 2011	Analysis of birth baseline data from infants enrolled in the NOURISH trial, an RCT evaluating an intervention to promote positive early feeding practices and healthy food preferences in infancy and childhood. Baseline assessment took place when infants were 4-7mo old, before randomisation. Data on feeding practices collected using a self-administered questionnaire collected at the time of the assessment.	Australia. First-time mothers delivering healthy, term infants with birth weights >2500g. Data for 612 infants analysed.	Early introduction of solids was defined as <4mo. Infants were breastfed (exclusively or predominantly), formula fed, or a combination of both.	Birthweight collected from hospital records and weights and lengths assessed at 4-7mo of age. Age and gender specific z-scores calculated. Rapid weight gain in infancy defined as >0.67 change in weight-for-age z-score from birth to assessment (at 4-7mo).	Infants were aged 4.3mo (SD 1.0) at the time of assessment. A total of 32.5% of infants had already started on solids by the time of the assessment (4-7mo) and of these infants, 24% had been introduced to solids before 4 mos. No effect was observed of early introduction of solids on weight gain during the study period. Formula feeding was found to be a factor associated with rapid weight gain during the study period. Infants who were formula fed were more likely to have been introduced to solids early.
Search et al., 2010	Melbourne Atopy Study Cohort. Children of 620 pregnant women recruited at antenatal clinics 1990 to 1994. Four-weekly telephone interviews collected data on infant feeding practices up to the age of 64 weeks. Further interviews at 78 weeks and 2yrs. Height and weight collected from at 10yrs of age.	Australia. Data from 307 subjects at follow-up analysed.	Age in weeks at first ingestion of solid foods. Feeding practices treated as continuous exposures in multiple logistic regression modelling.	BMI at age 10 years.	Later introduction of solid foods associated with reduced odds of being overweight/obese at 10yrs of age. Adjusted odds ratio (controlled for SES, parental smoking, and childcare attendance) = 0.903 per week, 95% CI 1.643 to 0.970, p=0.0005.

Study reference	Study design	Country/setting and participants	Definition of EBF and/or complementary feeding/weaning	Outcome measures	Findings
van Rossem et al., 2013	Generation R Study: Longitudinal birth cohort, with pregnant women with a delivery due date between April 2001 and Jan 2006, recruited during first antenatal visit. A food questionnaire at 12mo postpartum asked mothers to report the first introduction of different food types to the infant diet. Mothers reported via postal questionnaire sent 2mo after birth whether they were breastfeeding, formula feeding or a combination of both.	Rotterdam, The Netherlands. Data from 3184 infants analysed.	Age of introduction of solids categorised as "very early" (0-3mo, n=104), "early" (3-6mo, n=1120) and "timely" (after 6mo, n=771).	Infant length/height and weight measured at clinic visits at 1, 2, 3, 4, 6, 11, 14, 18, 24, 30, 36 and 45 mo of age.	38% of mothers introduced solids after 6mo of age. Before introduction of solids, weight gain was higher in children introduced to solids early (between 3 and 6mo) (z=0.65, 95% CI 0.34 - 0.95) compared to infants introduced to solids very early (before 3mo) or after 6mo. Weight-for-height change did not differ between the solid introduction groups after 12mo.
Woo et al., 2013	The Global Exploration of Human Milk study cohort - a multi-country prospective cohort of 365 predominantly breastfeeding mothers and infants recruited (shortly after birth, from a single hospital at each site) between Jan 2007 and Dec 2008. Eligibility determined in 2 phases: 1) when the infant was ~2wks old, including mothers aged 18-49y intending to BF at least 75% for at least 3mo and without medical issues that would interfere with BF, and 2) at the 4wk study visit, when mothers not achieving the 75% BF goal by 4wks postpartum were excluded and replaced in the cohorts. Assessment included baseline questionnaires, 5 in-person visits and weekly telephone surveillance in year 1. Data collected on infant feeding from weekly interviews, including current BF status and a 24hr food frequency recall of infant feeding.	USA, Mexico City & Shanghai, China (urban populations). N=285 infants remained in study at 1yr (92 (77%) in Cincinnati, 104 (87%) in Shanghai, and 89 (74%) in Mexico City).	Introduction of solid food was defined as the first reported intake of any solid or semi-solid food. "Breastfeeding intensity" determined during first year of follow-up as the number of times the infant had been fed human milk divided by the total number of items fed (x100), with 100% indicating exBF.	Weight and length measurements (measured at in-person visits) at age 1yr used in this analysis. BMI calculated as well as age and sex specific z-scores for BMI, weight-for-age, length-for-age, and weight-for-length.	Median introduction of any solid food was >1mo earlier in Shanghai (18wks) than in Cincinnati (23wks) or Mexico City (25wks). Infant anthropometry ay 1yr also significantly differed between cohorts. The timing of any solid food introduction did not significantly influence weight or length at 1yr of life (data not shown). Cohorts differed significantly on most baseline characteristics and on maternal obesity prevalence, gestational weight gain and infant birth weight.

Table 6.4: Cardiometabolic outcomes

Study reference	Study design	Country/setting and participants	Definition of exBF and/or complementary feeding/weaning	Outcome measures	Findings
Brazionis et al., 2013	Prospective birth cohort study (ALSPAC). Principal components analysis (PCA) used to identify dietary patterns from data collected from FFQs. Investigated associations between transition diets scores and BP measurements. Fully adjusted linear regression model included adjustment for child body size at 7.5 years to take into account any influence of BMI, waist circumference and height on BP.	UK (ALSPAC). "Transition diet" data collected at 6mo, 15mo and 24mo. Follow up at age 7.5yrs. N=1229 had complete data for analysis	Transition diets identified from PCA - characterised by variation in intake of foods consumed across infancy and toddlerhood. "Healthy" diet (more home-prepared and raw foods) and "Less healthy" (more ready-prepared, snack and processed foods).	Systolic and diastolic BP measured at 7.5yrs.	Each child was assigned a score for both the healthy and less healthy diets, so the relationship between diet score and BP was also examined by comparing BP in high and low scorers within each diet (i.e. using quartiles of diet score). Breastfeeding at 6mo inversely associated with less healthy diet but positively associated with healthy diet (suggesting that BF at 6mo may act as a marker for overall diet quality in infant and toddlerhood).
Fall et al., 2011	Five prospective birth cohort studies (although no data on the age at which complementary foods were introduced was available for Guatemala). Age of introduction of solid foods treated as a continuous variable in linear regression models.	Low- and middle-income countries (Brazil, India, Philippines and South Africa). Data pooled from 10,912 individuals (9640 when Guatemala not included) aged 15-41 years at follow-up	Complementary foods defined as semi-solid or solid foods.	Adult blood pressure (systolic and diastolic), fasting plasma glucose concentrations and adiposity measures (skinfold thickness, waist circumference, percentage body fat, overweight (BMI ≥25kg/m²) and obesity (BMI ≥30kg/m²)	The most frequent age at introduction of complementary foods was 0-3mo in Brazil and South Africa, 3-6mo in the Philippines and 9-12mo in India. Age at introduction of complementary foods was unrelated to blood pressure and glucose outcomes.
Veena et al., 2011	Birth cohort study in which detailed anthropometry collected at birth, annually until 5yrs and every 6mo thereafter. Data on age of introduction of solids collected at 1yr. Children assessed at 5 and 9.5 years of age: blood samples collected after an overnight fast and 30 and 120 minutes after an oral glucose load.	Mysore, India. 518 children had complete data, 90% of whom were breastfed for ≥6mo.	Age at starting "regular" complementary foods categorised into four groups: <4mo, 4mo, 5mo, and ≥6mo.	Glucose concentrations and insulin resistance (as measured by IR-HOMA)	Age at introduction of complementary foods was unrelated to glucose tolerance and IR-HOMA, at either 5yrs of 9.5yrs of age. [But early introduction of solids was associated with higher BMI at age 9.5yrs (p=0.051)]
Wilson et al., 1998	Follow-up study of a cohort of children for which infant feeding data was collected prospectively in the first two years of life. Infants recruited 1983-1986 and follow-up letters sent in 1990-1993.	Dundee, UK. Mean age at follow-up 7.2 years (range 6.9 - 10.0 years). Data on blood pressure from 301 children (45%) available for analysis.	Timing of introduction of solids categorised as before 15 weeks or 15 weeks or later. Milk feeding categorised as exBF for at least 15 weeks; partial BF (receiving formula supplements before 15 weeks, with a mean duration of BF of 9.5 weeks); and exclusive bottle-feeding.	Blood pressure measured at follow-up either at home or at a hospital visit.	Systolic blood pressure was associated with type of milk feeding: exclusively bottle fed infants had a higher systolic BP at 7 years than infants exclusively or partially BF. No significant differences were reported in blood pressure outcomes according to the age of introduction of solid foods.

Chapter 7. Micronutrients: annex tables

Table 7: Iron status in infancy

Study reference	**Study design**	**Country/setting**	**Participants** number, gender, age, ethnicity	**Definition of EBF and complementary feeding/weaning**	**Outcome measures**	**Confounders**	**Findings**
Abderlrazik et al, 2007	A randomised controlled trial to investigate the impact of long-term oral iron supplementation in breastfed infants. Infants were allocated to a treatment group (n=198) given iron containing multivitamin or control group (*n* = 50) given the same multivitamin but without iron, and subdivided according to clinical assessment into group A (well nourished) and group B (malnourished); both were further stratified according to basal blood iron status. Assessment was done after 6 and 12 months with concurrent collection of morbidity parameters (diarrhea and fever).	Egypt	248 exclusively breast-fed infants aged 4-6 months		Blood iron status determined at baseline, 6m and 12 m with concurrent collection of morbidity parameters (diarrhoea and fever).		After 6 m treatment, weight and length gain was better in treatment group compared with control especially evident in anaemic malnourished infants (p= 0.05). Morbidity risk was linked to immunologic background of infant; odds ratio for diarrhoea and fever was higher in malnourished compared to well nourished (p= 0.05) or iron therapy (p= for well-nourished non-anaemic treatment vs control > 0.05).
Andersson et al, 2011	A randomised controlled trial to compare the effects of delayed versus early umbilical cord clamping on infant iron status. Infants were randomly assigned to delayed umbilical cord clamping (≥180 seconds after delivery) or early clamping (≤10 seconds after delivery).	Sweden	400 full-term infants born after a low risk pregnancy		Haemoglobin and iron status at 4 months of age (with power estimate based on serum ferritin levels). Secondary outcomes included neonatal anaemia, early respiratory symptoms, polcythaemiaa and the need for phototherapy.		At 4m, infants showed no significant differences in haemoglobin concentration between the groups. Infants subjected to delayed cord clamping had 45% (95% CI: 23% to 71%) higher mean ferritin concentration (117 µg/L v 81 µg/L, p<0.001) and a lower prevalence of iron deficiency (1 (0.6%) v 10 (5.7%), p =0.01), Secondary outcomes: delayed cord clamping group had lower prevalence of neonatal anaemia at 2 days of age (2 (1.2%) v 10 (6.3%), p =0.02,). No significant differences between groups in postnatal respiratory symptoms, polycythaemia, or hyperbilirubinaemia requiring phototherapy.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
Domellöf et al, 2002	25 infants randomly assigned to receive either 1) iron supplements (1mg/kg/d) from 4-9m, 2) placebo from 4-6m and iron supplements from 6-9m of age, or 3) placebo from 4-9m. Infants were EBF to 6m and partially BF to 9m. Iron absorption assessed by giving 58Fe with mother's milk at 6 and 9 m. Blood samples were obtained at 4, 6 and 9m, and CF intake was recorded at 9m.	Sweden	Healthy, term breastfed infants of normal bodyweight (>2500g)				At 6m, mean fractional iron absorption from human milk was relatively low (16.4± 9.3%) but was higher in iron-supplemented and unsupplemented infants. At 9m, iron absorption from human milk remained low in iron-supplemented infants (16.9±9.3%) but was higher (P=0.01) in unsupplemented infants (36.7±18.9%). Iron absorption at 9m was not correlated with iron status but was significantly correlated with intake of dietary iron, including supplemental iron.
Lind et al, 2004	Community-randomised controlled trial to compare the effects of combined iron and zinc supplementation in infancy with the effects of iron and zinc as single micronutrients on growth, psychomotor development, and incidence of infectious disease. Infants randomly assigned to one of four treatment groups to receive daily supplementation of: (1) iron (10mg/day), (2) zinc (10mg/day), (3) iron (10mmg/day) + zinc (10mg/day), (4) placebo. Each dose of all treatments also contained 30mg ascorbic acid.. Duration 6 months	Indonesia	Total (n=680). Each group (n=170) Age 6 months All Haemoglobin >90g/L. 41% anaemic		Anthropometric indexes, Bayley Scales of Infant , Development, Behaviour ratings, morbidity		Baseline: no significant differences between groups. Treatment: significant interaction between iron and zinc treatment for psychomotor development index (PDI). Significant iron effect on PDI (p=0.042). no other group significant. No effect of iron and zinc combined on PDI. No treatment effect on mental development index or behaviour. Significant interaction between iron and zinc for weight for age z score, knee-heel length. Weight for age z score was higher in the zinc group than in placebo and iron and zinc groups. Knee-heel length was higher in the zinc and iron groups than placebo group.. no significant effect on morbidity was found.

Study reference	Study design	Country/setting	Participants number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
Majumdar et al, 2003	A prospective, double-blind, placebo-controlled trial to study the effect of iron therapy on the growth of iron replete and iron deficient children. 100 healthy children, who were iron replete (group I) according to present criteria, were randomly allocated to receive iron supplements 2 ng/kg/day (group IA) or placebo (group IB). 50 iron-deficient children (group II) were administered iron syrup 6 mg/kg/day.	India	150 children (aged 6-24 months) were included in the study.		Growth parameters (weight, length and head-circumference) and haematological parameters were studied for 4 months.		Iron therapy, as compared with placebo, produced a significant improvement of mean monthly weight gain ($p < 0.001$) and linear growth ($p < 0.001$) in the iron-deficient children. However, it significantly decreased the weight gain ($p < 0.001$) and linear growth ($p < 0.001$) of iron-replete children.
Silva et al, 2008	A prospective randomised study to compare the effects of different prophylactic iron does on the growth and nutritional status of non-anaemic infants. Infants randomly allocated into 3 groups who received the following prophylactic doses of iron supplement (ferrous sulfate): 1) 1 mg/kg/day (n = 39); 2) 2 mg/kg/day (n = 36); and; 3) 25 mg/week (n = 39). Supplementaion was given for 16 weeks.	Brazil	Infants aged 5.0 to 6.9 months who met the inclusion criteria and showed capillary hemoglobin >or= 11 g/dL		Weight and length. Nutritional status evaluated by comparing z scores for weight/age, length/age and weight/length based on the World Health Organization (2006) references. Morbidity information was collected during monthly visits.		The groups showed similar nutritional status before supplementation. There were no differences in daily nutrient intake among groups. During the study, weight and length gain, and increments in anthropometric indices did not differ statistically among supplemented groups. The occurrence and duration of morbidity episodes did not differ statistically among groups. In general, improvements were observed in both weight/age and weight/length indices in the population under study, whereas length/age showed no differences before and after supplementation.
Yang et al, 2009	Data obtained from 6 RCTs conducted in 4 countries. Venous blood obtained from infants at 6m (±1 wk.) to assess Hb and iron status - assessed the prevalence of ID and IDA and the risk factors associated with ID and IDA.	Ghana, Honduras, Mexico and Sweden	404 fully breastfed infants with a birth weight >2500g.	Only infants who were fully breastfed (i.e. breast milk was the only source of milk) were included in the analyses.	ID (ferritin <12µg/L) and IDA (ferritin <12µg/L and haemoglobin <105g/L).	Explored the influence of variation in timing of umbilical cord clamping.	The percentages of infants with ID were 6% in Sweden, 17% in Mexico, 13–25% in Honduras, and 12–37% in Ghana. The percentages with IDA were 2% in Sweden, 4% in Mexico, 5–11% in Honduras, and 8–16% in Ghana. With data pooled, the key predictors of ID (20%) were male sex [adjusted odds ratio (AOR): 4.6; 95% CI: 2.5, 8.5] and birth weight 2500–2999 g (AOR: 2.4; 95% CI: 1.4, 4.3). The predictors of IDA (8%) were male sex (AOR: 7.6; 95% CI: 2.5,

Study reference	Study design	Country/setting	Participants number, gender, age, ethnicity	Definition of EBF and complementary feeding/weaning	Outcome measures	Confounders	Findings
							23.0), birth weight of 2500–2999 g (AOR: 3.4; 1.5, 7.5), and weight gain above the median since birth (AOR: 3.4; 95% CI: 1.3, 8.6). The combination of birth weight 2500–2999 g or male sex had a sensitivity of 91% for identifying ID and of 97% for identifying IDA.

Chapter 8. Eating and feeding of solid foods: annex tables

Table 8.1: Sensitive window for the introduction of complementary foods

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures (including definition of breastfeeding exposure, complementary feeding/weaning where appropriate)	Confounders	Findings
Mennella & Beauchamp, 1996	An experimental study to investigate the age-related changes in the acceptance of a protein hydrolysate formula (Nutramigen). Whether the infants' response to Nutramigen was related to their mothers' willingness to try new foods was also examined. Two groups of healthy infants who had never experienced any type of protein hydrolysate formula were recruited. Group 1 (*n*=14) were tested when they were <2 months of age and retested at 7-8 months, while group 2 (n=14) were only tested at 7-8 months. On 2 consecutive testing days, half of the infants in each group were fed their familiar brand of milk- or soy-based formula on day one and Nutramigen on day two; the order was reversed for the remaining half.	USA	28 mother-infant pairs. **Group 1**: 1st test session mean age = 47.9±6.0 days; 2nd test session mean age = 217.8±6.2. **Group 2**: 2nd test session mean age = 235.0±6.9.	Intake (ml) and time spent feeding (min). Mothers' attitudes about food and eating habits (derived from questionnaires measuring variety seeking tendency, food neophobia, propensity to approach/avoid new foods). Two comparisons were conducted to determine whether there was an effect of age on the acceptance of Nutramigen: inter-group comparison (Group 1<2m vs Group 2 7-8m) and intra-group comparison in Group 1 (<2m vs 7-8m).	Information collected on types of formulas and foods fed to infants from birth; breastfeeding history.	The 1st comparison (Group 1<2m vs Group 2 7-8m) showed that there was a significant effect of age on the infants' intake of Nutramigen relative to regular formula (p=0.00004). Post hoc t tests found that although both groups of infants consumed less Nutramigen, the older infants rejected it more (p=0.000002) than did the younger infants (p=0.038). The 2nd comparison of group 1 infants at 2 different ages found a significant effect on the relative amount of Nutramigen consumed (p=0.00022). Older infants consumed significantly less Nutramigen (p=0.0004) and spent less time feeding (p=0.000195). A comparison of the 2 groups of older infants found that a single exposure to Nutramigen did not alter the infants' response to Nutramigen (p=0.65) or duration of the feed (p=0.81). When mothers offered their infants their regular formula approximately 10 minutes after the formal test, the amount of regular formula consumed by the younger infants did not differ on the 2 testing days (regular vs Nutramigen test days; p=0.16) implying that these younger infants satiated equally on the 2 test days. In contrast, the older infants consumed significantly more of their regular formula on the day they were tested with Nutramigen (Group 1 p= 0.01; Group 2 p= 0.001). There was a significant correlation between the mothers' eating habits and the younger infants (<2 months) response to Nutramigen. Mothers who exhibited a greater willingness to consume new foods (p=0.003) or less food neophobia (p=0.04) had infants who consumed relatively more Nutramigen.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures (including definition of breastfeeding exposure, complementary feeding/weaning where appropriate)	Confounders	Findings
Mennella & Beauchamp, 1998	On 2 consecutive days, formula fed infants (aged between 2-40 weeks) who had no prior exposure to protein hydrolysate formulae, received their normal brand of cows' milk or soya based formula at 1 testing session and Alimentum (a protein hydrolysate formula judged to taste sweeter and less sour than Nutramigen but to retain a distinct, unpalatable flavour) during the other. Mothers were unaware of the order of testing which was counterbalanced between subjects. Infants proportional intake of protein hydrolysate formula relative to total consumption (hydrolysate/(hydrolysate+regular formula) was plotted against infant's age in weeks	USA	56 infants aged 2-40 weeks.	Infants proportional intake of protein hydrolysate formula relative to total consumption (hydrolysate/(hydrolysate+regular formula)		There was a significant correlation between the infants' age and their acceptance of Alimentum relative to their regular brand of cows' milk or soy based formula (*p*<0.0001). Rejection of the hydrolysate formula first became apparent in infants between the ages of 17 and 24 weeks (*p*=0.003). All infants in this study were receiving solids foods at 4 months of age, however, whether infants <u><</u>4 months were receiving solids or were exclusively formula fed did not appear to alter acceptance of Alimentum.
Mennella et al, 2004	Longitudinal experimental study to investigate the impact of early experience with infant formulas on subsequent preferences. Infants whose parents had chosen to formula-feed were randomised into 1 of 4 groups by the 2nd week of life. Group 1 was assigned to be fed a milk-based formula (Enfamil) for 7 months, group 2 was assigned to Nutramigen for 7 months, group 3 were assigned to be fed Nutramigen for 3 months (then Enfamil for the remaining 4 months), and group 4 were assigned to be fed Enfamil for 4 months (1st 2 months Enfamil, then 3 months Nutramigen, followed by 2 months Enfamil). After 7 months of exposure (when infants aged 7.5 months), infants were videotaped on 3 separate days while feeding, in counterbalanced order, Enfamil, Nutramigen, and Alimentum (a hydrolysate formula to which no infants had been exposed).	USA	Mothers who had chosen to formula-fed their term newborns. Mother-infant pairs randomised into 1 of 4 groups: Group 1 (*n*=14); Group 2 (*n*=12); Group 3 (*n*=15); Group 4 (*n*=12).	Intake (ml); duration of formula feeding (minutes); frequency of negative facial expressions during the first 2 minutes of feeding; mothers' judgements of infants' acceptance/enjoyment of the formulas during each of the 3 test sessions conducted at the end of the 7 month exposure period.		There were no significant differences between the groups in the infants' acceptance of the formula they were fed during the 7 month exposure period (*p*=0.44). There was a significant interaction between groups and the infants' acceptance of the 3 types of formulae when tested at the end of the exposure period (*p*<0.00005). The 3 groups of infants exposed to Nutramigen consumed significantly more and spent more time feeding on Nutramigen and Alimentum compared to those infants who were fed only Enfamil during the 1st 7 months of life (*p*<0.05), however, Group 2 had the greatest acceptance of the Nutramigen compared to the other 3 groups. There was a significant effect of group on the number of negative facial expressions displayed while feeding the formulas (*p*<0.5); infants in Groups 2, 3 and 4 made significantly fewer negative facial responses while ingesting Nutramigen when compared to infants only exposed to Enfamil (Group 1). There was a significant group-by-formula interaction in mothers' perceptions of their infants' behaviours that was consistent with the infants' acceptance patterns.
Mennella et al , 2011	A randomised clinical trial aiming to characterise the timing and duration of a sensitive period in human flavour learning in early infancy (<4 months), using response to protein hydrolysate formula (PHF) relative to cow's milk based formula (CMF) as a model system. Healthy infants whose parents had chosen formula feeding were randomly assigned to 1 of 6 groups at age 0.5 m. Group 1: control group fed CMF for 7 m; Group 2: control group fed PHF for 7 m; Group 3: fed PHF for 1 m from 1.5 m of age (and CMF otherwise); Group 4: fed PHF for 3 m from 1.5 m of age (and CMF	USA	Women who had recently given birth and chosen to exclusively formula feed their healthy, full term newborns CMF (or to predominantly formula feed but breastfeed once or twice a day for the first months of life) were recruited. 69 mother-infant pairs. Group 1 *n*=13; Group 2 *n*=12;	Monthly assessment of intake (ml) and maternal ratings of infants' enjoyment of the formula. At the end of the study: intake (ml); maternal ratings of infants' enjoyment of the formula; frequency of distaste/rejection behaviours during the first 2 minutes of feeding. For each measure, a proportional score was calculated by dividing the infant's response to the PHF by his/her response to the PHF plus CMF [PHF/(PHF+CMF)		Infants in Groups 3, 5 and 6 consumed significantly less PHF than CMF at the beginning of the 1st month of exposure (*p*<0.0001). Infants in Group 6 who 1st experienced PHF at 3.5m consumed significantly less PHF during their initial taste test than did infants in Groups 3 and 5. When compared with PHF intake at the beginning of the month, PHF intake significantly increased at the end of 1m of exposure for each of the 3 groups (*p*<0.0001) and was nearly as great as CMF acceptance. When PHF acceptance was assessed at 7.5m, there were significant differences based on the ***duration*** of PHF exposure (0, 1, 3 and 7 m exposure)

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures (including definition of breastfeeding exposure, complementary feeding/weaning where appropriate)	Confounders	Findings
	otherwise); Group 5: fed PHF for 1m starting at 2.5m (and CMF otherwise); Group 6: fed PHF for 1m starting at 3.5 m (and CMF otherwise). At the beginning of each 1m cycle a brief taste test was conducted. Acceptance of PHF was tested when infants were 7.5m old (i.e. at the end of the 7m exposure period).		Group 3 *n*=11; Group 4 *n*=11; Group 5 *n*=11; Group 6 *n*=11.			in relative intake (p<0.001), maternal perceptions (p<0.001), and rejection/distaste behaviours (p=0.002). Three months exposure to PHF led to similar acceptance to that at 1m exposure (Groups 6 and 3). Although PHF acceptance in these 2 groups was greater than that of the CMF control group (Group 1), it was less than the group exposed to PHF for 7 months (Group 2). In general, patterns of maternal perceptions and frequency of distaste/rejection behaviours were consistent with the differences in intakes that were based on duration of exposures. Significant differences were also observed based on the ***timing*** of exposure in relative intake (p=0.02), maternal perceptions (p=0.01) and rejection/distaste behaviours (p=0.04). Infants who started feeding PHF before 3.5 m consumed relatively more PHF than did the CMF control group, however, if feeding PHF began when infants were 3.5m old, intake of PHF was no different than the CMF control.
Mennella & Castor, 2012	Randomised controlled to trial to determine the effects of duration of exposure to extensively hydrolysed protein hydrolysate formula (ePHF) before 4m on the acceptance of a food (broth) containing an exemplar of the flavour during complementary feeding. Formula-fed infants randomised into 4 groups at 0.5m: 1) control group fed cows' milk formula (CMF) for 8m; 3 groups fed ePHF for 1, 3, or 8m and CMF otherwise. Infants acceptance of a savoury and plain broth measured at 8.5m of age.	USA	47 mothers who were formula feeding their infants (41.3% black, 21.7 white, 19.6% Hispanic, 17.4% mixed race/other).	Total intake (g) and rate (g/min) of each feed and mothers' rating of their infant's enjoyment of the broth during each test session. For each infant and each measure, a relative score was calculated by dividing infant response to savoury broth by responses to savoury broth plus plain broth (to eliminate absolute differences in responses that might be due to individual differences).		Infants fed ePHF for 3 or 8m, but not 1m, showed greater acceptance of the savoury broth relative to the plain broth (p<0.01) and consumed it at a faster rate (p<0.01).

Table 8.2: Repeated exposure

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures (including definition of breastfeeding exposure, complementary feeding/weaning where appropriate)	Confounders	Findings
Birch et al, 1998	Study to investigate the number of feedings required to increase intake of a new target food and whether exposure effects generalised to other foods (*same:* another manufacturer's preparation of the target food; *similar:* two foods presented from the target food category, i.e. fruits or vegetables; *different*: food presented from a different food category). Infants were assigned to one of two feeding groups, group 1 received repeated exposure to the target fruit (banana) and group 2 to the target vegetable (peas). Intake data were collected at pre-exposure (5 days), repeated exposure (10 days) and post-exposure (6 days) feedings. *Pre-exposure period:* infants fed the target food on day 1, and on the subsequent 4 days received the same, similar (2 foods) and different foods, in random order; *repeated exposure*: target food offered at the same meal each day; *post-exposure:* target food and the other foods presented again.	USA	39 infants (21 females, 18 males) aged between 16-31 weeks, mean age 24 weeks.	Intake used as a measure of acceptance. Intake of the target food measured at pre-exposure, during the exposure series, and at post exposure; intake of the same, similar and different foods was measured during pre- and post-exposure.	Gender, milk feeding regime, maternal and paternal age, average education of mothers and fathers, whether mother worked and if so, work pattern.	Exposure to the target food significantly increased consumption of the target food from a mean of 35g pre-exposure to 72g at post-exposure (p<0.01). Much of the pre-post exposure increase in intake occurred very early in the sequence of feeding: intake of the target food increased significantly (p<0.01) between initial pre-test day to the first day of the exposure. Intake continued to increase during the 10 day exposure period. Intake of different food was unchanged. Intakes of same and similar foods increased with target food exposure.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures (including definition of breastfeeding exposure, complementary feeding/weaning where appropriate)	Confounders	Findings
Barends *et al*, 2013	Intervention study to investigate the effects of repeated exposure to either vegetables or fruit on an infant's vegetable and fruit acceptance during the first 18 days of complementary feeding. Following 5 days on rice flour porridge to accustom infants to eating solids, infants were randomly assigned to one of four treatment groups. Two groups received exclusively vegetable purees (group 1: green beans the group 2: artichoke) as targets every other day for 18 consecutive days. The other two groups received exclusively fruit purees (group 3: apple and group 4: plum) as the target. On the other 9 days, the vegetable groups received other types of vegetables and the fruit groups other fruit. On day 19, the vegetable group consumed their first fruit puree and the fruit group consumed their first vegetable puree. Vegetables or fruits were given in the laboratory on days 1, 2, 17, 18 and 19, and at home on days 3-16.	The Netherlands	101 healthy infants aged 4-6 months who had not commenced complementary feeding. Mean age at the start of the intervention was 5.4±0.8 months. At the start of the intervention, 53% were still breastfed, and 37% of them were exclusively breastfed. Of the formula fed infants, 19% had been breastfed for 12 weeks or more.	Vegetable and fruit intake (g) over time. Liking ratings (9 point scale) provided by mothers for infants enjoyment of each food.	Two questionnaires administered to capture infant data (including feeding history, birth weight) and maternal data (weight and height, education level, maternal food neophobia).	Mean vegetable intake in the vegetable groups increased significantly over time, from 24±28 g (mean ± SD) on days 1 and 2 to 45±44g on days 17 and 18 (p<0.0001). Fruit intake in the fruit groups increased significantly from 46±40 to 66±42g (p<0.001). Fruit intake was significantly higher than vegetable intake from the start (p<0.01). Repeated exposure to fruit had no effect on the vegetable intake. and vice versa; on day 19, the fruit groups intake of green beans on first exposure was similar to the intake observed in the vegetables group on first exposure. The mean intake of green beans and plums increased significantly with repeated exposure (p=0.016 and p<0.001, respectively*)*. Mean apple intake was high from the start and although intake increased over time, this was not statistically significant. No significant increase was observed after repeated exposure to artichoke. Maternal liking ratings for a specific food showed a high and positive correlation with the food's measured intake (p<0.001).
Barends et al, 2014	Follow up study of infants (Barends *et al*, 2013) to determine whether the effects of introducing exclusively vegetable purees in the early complementary feeding period persist at 12 and 23 months. Infants' daily consumption of vegetables and fruits at home was reported by their parents in a 3 day food diary. Intake of the same green beans and apple purees as those offered during the baseline study was measured in the laboratory at 12 and 23 months.	The Netherlands	Of the 101 original parent-infant pairs, 84 participated at 12±1.4 months and 81 at the age of 23+1.0 months.	Infants' intake of green beans and apple purees in the laboratory at 12 and 23 months of age, and daily vegetable and fruit intake reported in a 3 day food diary. Mothers rated how much their children liked each feeding using a 9 point scale, and rated how often their child ate the particular food at home and how much the child liked it.	Information about infants' and mothers' general characteristics was collected via questionnaires (see above). At 12 and 23 months, the infant questionnaire included questions on pickiness and openness to new foods.	At 12 months, children who had been introduced exclusively to vegetables during early complementary feeding had a significantly higher vegetable intake (by 38%) at home than children who had been introduced exclusively to fruit purees (p<0.019). At 23 months, the difference in vegetable intake between these groups was no longer apparent. At 12 months, intake of green beans in the laboratory did not differ significantly between vegetable and fruit groups, and at 23 months had dropped significantly for both groups. Mean apple intake was relatively high and not significantly different between both the vegetable and fruit groups at 12 months and 23 months.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures (including definition of breastfeeding exposure, complementary feeding/weaning where appropriate)	Confounders	Findings
Sullivan & Birch, 1994	To examine the effects of dietary experience and milk feeding regime on acceptance of first vegetables, infants were randomly allocated to one of four treatment groups receiving 1) salted peas; 2) salted green beans; 3) unsalted peas; and 4) unsalted green beans, on 10 occasions for a 10 day period. As a control for possible confounding (e.g. growth), infants were fed one other solid food at the beginning and end of the study. This was pureed chicken in all cases except one where tofu was offered as the vegetarian alternative. Infants' initial intake of both salted and unsalted versions of one vegetable was also measured. Intake was also measured 1 day after completion of the exposure period and 1 week after completion of the exposure period.	USA	36 infants; age range 17-27 weeks (mean 22 weeks). 19 infants were breastfed (of which 10 received some supplementary formula) and 17 infants were exclusively formula fed. Infants received cereals as a first solid food at a mean age of 15 weeks.	Intake of the vegetable consumed during the 10 day exposure period; 1) before the exposure period; 2) immediately after the exposure period; 3) after 1 week delay. Intake of a control food also measured before and after repeated consumption of the vegetable. Adult ratings of the infants' videotaped responses during test feedings were also obtained before and after exposure.		After repeated exposure, infants increased their intake of the new food ($p<0.001$), and increased intake was observed regardless of whether the infants were exposed to salted or unsalted versions of the vegetable. There was no clear evidence that the presence of salt enhanced infants' acceptance. Adult ratings of the infants' responses during feeding were related to infants' intake; the more infants consumed during a feeding, the higher the adults rated infants' liking. Adults' ratings of infants' nonverbal responses were positively correlated with infants' intake ($p<0.05$). There was a significant increase in ratings for both vegetables, regardless of whether they were salted or unsalted. Breastfed infants showed greater increases in intake of the vegetable following exposure ($p<0.05$) and had an overall greater level of intake than formula-fed infants (p<0.001).
Maier et al, 2007	Study to investigate whether repeated exposure to an initially disliked vegetable can improve consumption in the weeks following the introduction of solid foods. During the first 1-2 months of complementary feeding, mothers were asked to identify a vegetable puree that her infant disliked so much that she would not normally offer it again. Mothers were then asked to offer that vegetable on alternate days for a 16 day period and to offer a well-liked one (carrot puree) on the other days. Nine months after this phase was completed (infants aged 15-19 months), mothers (n=48) completed a food consumption and acceptance questionnaire including questions regarding intake of, and liking for, the test vegetable.	Germany	49 mother-infant pairs. Mean age of infants at the start of the study was 7.0±0.9months. The time since the mother decided her infant disliked a vegetable and the beginning of the repeated exposure to that vegetable varied from 2-9 weeks. Of the 49 infants, 24 had been breast fed (168±70 days) and 25 had been formula fed (22 exclusively on formula and 3 breast fed for 2 weeks or less).	Intake (g) and acceptance based on maternal rating of how much the infant had liked the vegetable measured at each meal. Food consumption and acceptance questionnaire completed 9 months after the initial phase.	Information collected on maternal food neophobia, variety-seeking behaviour with respect to food, and anxiety traits.	Over the 8 exposure days that the initially disliked vegetable was offered, mean intake increased linearly (r=0.99) from 39±29 to 174±54g ($p<0.0001$). Intake of the initially liked vegetable increased from 164±73 to 186±68g ($p<0.03$). Paired *t*-tests showed that over the first 7 exposures, intake of the initially disliked vegetable was significantly less than that of the initially liked vegetable after the same number of exposures. By the eighth exposure the difference was no longer significant. There was no significant difference between breast and formula fed infants in intake of the initially liked vegetable, however, type of milk feeding did have an effect on intake of the initially disliked vegetable. On the first day of feeding the initially disliked food, breastfed infants consumed significantly more than formula fed infants ($p<0.003$). By the seventh exposure day, intakes were the same. The pattern of mother-

Study reference	Study design	Country/setting	Participants number, gender, age, ethnicity	Outcome measures (including definition of breastfeeding exposure, complementary feeding/weaning where appropriate)	Confounders	Findings
						reported liking scores was similar to that for intake. At the 9 month follow stage (*n*=48), 63% infants were still eating and liking the initially disliked vegetable.

Table 8.3: Exposure to a variety of flavours

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures	Confounders	Findings
Coulthard et al, 2014	To examine the effectiveness of different vegetable exposure methods (variety versus single taste) over a 9 day exposure period in 2 groups of infants; those introduced to solids before 5.5 months of age and those introduced after 5.5 months of age. Half of the infants in each age group were randomly assigned to 1 of 2 conditions; the single taste condition, where infants were given carrot for a 9 day period, and the variety condition, where infants were given parsnip, courgette or sweet potato. A baseline measurement of the infants' acceptance of a vegetable (carrot) was taken prior to the exposure period. At the end of this period, infants' acceptance of a new vegetable (pea puree) was measured.	UK	60 healthy term infants. The range of introduction of complementary foods was 4-6 months, mean age 5.18±0.84. In the early introduction group the mean age of introduction was 4.50±0.43 (range 4-5 months) while in the later introduction group, the mean age of introduction to solid foods was 5.91+0.03 (range 5.5-6 months).	Intake (g) and infant's enjoyment of the food.	Maternal age, years in education, and fruit and vegetable consumption.	No main effect of the age of introduction of complementary foods or exposure type (single taste versus variety) on consumption o the baseline vegetable (carrot), and this was also true for consumption of the new vegetable (pea) following the 9 day exposure period. A significant interaction between age of introduction and exposure group on consumption of the new vegetable (pea), with infants who were introduced to complementary foods later and who were exposured to a variety of vegetables consuming significantly more pea puree than those in the single taste group (*p*<0.05).
Forestell & Mennella, 2007	A 12 day experimental study to evaluate the effects of breastfeeding and dietary experience on infants' acceptance of a fruit (peaches) and a green vegetable (green beans). Infants were randomly assigned to 1 of 2 groups. Group 1 (GB) was fed green beans while group 2 (GB-P) was fed green beans and then peaches throughout the 8 day home exposure period (days 3-10). Acceptance of both foods was assessed before (days 1 and 2) and after (days 11 and 12) the home-exposure period.	USA	45 healthy, term infants aged between 4-8 months. The ethnicity of the subjects was 36.4% black, 45.5% white, 6.8% Hispanic, 11.4% other/mixed ethnicity. 44% infants had been breastfed.	Amount of food consumed (grams and calories), duration of feeding (minutes), and rate of feeding (grams/minute). Infants' facial expressions during feeding, as a measure of hedonic responses or liking (frequency of distaste facial expressions made/spoonful offering during first 2 minutes of feeding). Observations made by trained facial expression rater, blinded to infants' group designation. Mothers' rating of their infants' enjoyment of the food.	Information on infants' feeding history (including breast and formula feeding) and mothers' eating habits were collected by questionnaire. Data on food neophobia and infant temperament were also collected.	Initially, infants consumed more calories from peaches than from green beans. Infants who were breastfed for the first few months of life consumed significantly more peaches (*p*<0.001), for longer periods of time (p<0.01), at a faster rate (p<0.03) and displayed fewer negative facial responses overall during feeding (p<0.05), compared with formula fed infants. Mothers of breastfed infants ate significantly more fruits during the previous week compared with formula-feeding mothers (p<0.04). During the exposure period, the 2 groups ate similar amounts of green beans. Repeated exposure with or without peaches led to significant increases in infants' consumption of green beans (p<0.001) and the rate at which they ate this food (p<0.001). There was no significant interaction between infants' feeding history and treatment group; both breastfed and formula fed infants increased acceptance of green beans after the home-exposure period. There was a significant interaction between the treatment group and the time for the types of facial expressions made during feeding of green beans (p<0.04); only infants who experienced green beans with peaches displayed fewer facial expressions of distaste during feeding. Mothers were apparently unaware of these changes in green bean acceptance following the exposure period.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures	Confounders	Findings
Forestell & Mennella, 2012	Study to determine whether mothers' assessment of their infants' temperament is associated with objective measures of the infants' acceptance and liking for a green vegetable (green beans). Infants were video-recorded as their mothers fed them green beans and from this, the frequency of facial distaste expressions made during the first 2 minutes of feeding was determined.	USA	92 infants (mean age 6.3±0.1 months). 46% exclusively breastfed for at least 2 months; 28.3% formula fed with <7 days exposure to breast milk. Mean age of introduction of cereal 4.0±0.1 months. All infants had been eating cereal for a mean of 2.2±0.1 months at the time of the study. At the time of the study, 49% infants were still receiving breast milk on a regular basis.	Frequency of facial distaste expressions made during the first 2 minutes of feeding; intake (g); time spent eating (minutes); maternal ratings of infants' enjoyment of the vegetable, infant temperament (using the Infant Temperament Scale which includes measures of approach/withdrawal, mood, adaptability, persistence, distractibility).	Information on infants' feeding history (including breast and formula feeding, timing of complementary feeding, foods introduced including past exposure to green beans) and mothers' eating habits were collected by questionnaire.	There were no differences in the amount of green beans consumed nor in the frequency of facial responses expressed between breast and formula fed infants. After controlling for previous exposure to vegetables, analyses showed that infants who scored highly on the approach dimension on the temperament scale ate significantly more food (*p*<0.02), for a longer period of time (p<0.02), and expressed fewer distaste facial expressions (e.g. fewer nose wrinkes (p<0.04)) during the feeding session. Mediation analyses were performed to determine whether infants' temperament was directly associated with mothers' ratings of the infants' enjoyment of the food, or whether this was an indirect relationship mediated by infants' acceptance behaviours during feeding. These analyses supported the latter, i.e. that the relationship between mothers' ratings and temperament was mediated by the amount of time infants spent eating the vegetable. Regression analyses suggested that the number of squints the infant made during the meal was also linked to mothers' ratings of the infants' enjoyment. Mothers appear to respond to facial expressions and time spent eating independently of their infants' temperamental characteristics when judging enjoyment of food.
Fildes *et al*, 2015	Study to investigate the impact of advising parents to introduce a variety of single vegetables as first foods on infants' subsequent acceptance of a new, unfamiliar vegetable. Infants were randomly assigned to either an intervention group (*n*=75) receiving guidance on introducing five vegetable (one per day) as first foods repeated over 15 days, or a control group (*n*=71) receiving country-specific 'usual care'. Equal representation of breast-fed and formula-fed infants was ensured across the groups and within each country, using block randomisation. One month post-intervention, infant's consumption and liking of an unfamiliar vegetable was recorded. An unfamiliar fruit (peach puree) was also offered which acted as a control.	UK, Greece and Portugal	4-6 month old infants. Mean age at introduction of solid foods was 5.2±0.6 months in both the intervention and control groups.	Infant's consumption (g) and liking (maternal and researcher rated) of an unfamiliar vegetable (artichoke puree) were assessed one month post-intervention. Primary analyses were conducted on the whole sample and secondary analyses conducted separately by country.	Mothers completed questionnaires about themselves and their infant prior to the intervention and at follow up (1 month after the introduction of solid foods), which included items on demographics and infant feeding practices.	The mean intake of the unfamiliar vegetable puree was almost 10g higher among the intervention group compared with the control group, however, primarily analyses examining the effect of the intervention in the three countries combined (n=139) found no significant main effect of the intervention on vegetable intake, controlling for the effect of country. Researchers rated infants in the intervention group as liking the unfamiliar vegetable significantly more than the control infants (*p*<0.032). No main effect of the intervention was found for either intake or liking ratings for fruit. Separate analyses by country found a significant effect of the intervention on intake of the unfamiliar vegetable in the UK (*p*=0.003). UK infants in the intervention group were also rated as liking the puree significantly more than control infants by both mothers (p<0.001) and researchers (p<0.001). No effect was seen in intake or liking ratings for the unfamiliar fruit for either UK group. No significant intervention effect on infants' intake or liking ratings was observed in either the Greek or Portuguese sample.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures	Confounders	Findings
Gerrish & Mennella, 2001	An experimental study to test the hypothesis that acceptance of new foods by formula fed infants could be facilitated by providing the infants with a variety of flavours at the beginning of the complementary feeding period, and that infants who had previously been exposed to fruit would be less likely to reject new vegetables than would infants without that experience. For the 12 day experimental period, infants were randomly assigned to 1 of 3 experimental groups (16 infants/group). Some infants had previously consumed fruits. On days 1 and 11 all infants were fed pureed carrots and on day 12 received pureed chicken. For the 9 day exposure period, group 1were fed carrots (the target vegetable); group 2 were fed only potatoes; and group 3 received a variety of vegetables that did not include carrots.	USA	48 healthy, term infants. On day 1 of testing, infants had been eating cereal for a mean 3.8±0.4 weeks, indicating that complementary foods had been introduced at around 4.0±0.1months of age. Mean age of infants: group 1) 4.6±0.2; group 2) 4.5±0.2; and group 3) 4.8±0.1.	Intake (g), duration of feeding (minutes), rate of feeding (g/minute), mothers' rating of infants' enjoyment of the food.	Mothers completed a questionnaire to determine the frequency with which they ate carrots and chicken since their baby's birth and throughout the 9 day exposure period. Maternal variety-seeking behaviour in relation to food was also assessed.	Infants in the carrot and variety groups, but not those in the potato group, ate significantly more carrots following the 9 day exposure period than at baseline (p<0.002 and p<0.003, respectively). Infants' acceptance of chicken was significantly affected by the type of vegetable consumed during the exposure period, with the variety group consuming more than the carrot group. Exposure to fruit did not adversely affect infants' acceptance of carrots during their first exposure to this vegetable at the start of the study and daily compared to no fruit consumption was associated with improved initial acceptance of carrots (p<0.007).
Hetherington et al, 2015	Intervention study (35 day duration) to test a step-by-step exposure to vegetables in infants usual milk (breast or formula) then rice during complementary feeding (CF) on intake and liking of vegetables. Just before the start of CF, mothers were randomised to an intervention (IG, n=18; 6BF) or control group (CG, n=18; 6BF). IG infants received 12 daily exposures to vegetable puree added to milk (days 1-12), then 12 x 2 daily exposures to vegetable puree added to rice at home (days 13-24). Plain milk and rice given to CG. Both groups then received 11 daily exposures to vegetable puree. Intake was weighed and liking rated on days 25-26 and 33-25 after the start of CF in the laboratory, supplemented by the same data recorded at home. Vegetables (carrots, green beans, spinach, broccoli) were rotated daily.	UK	40 mother: infant pairs (complete data obtained from 36, 18 in each group). Infants suffering from a chronic health condition requiring medication, those born prematurely <37 weeks gestation, fed hydrolysed-protein formula, or with a known food allergy, were not eligible to participate.	Mothers were asked to complete a 35 day diary in which they recorded everything the infant consumed each day, and the start and end time of each feed, and the amount consumed. Over the course of each day they record their infant's reaction to a feed using a 9 point liking scale. To evaluate the duration of the effects of the intervention, follow-up measurements were carried out 6 and 18 months after completion of the study (i.e. when children were approximately 12 and 24 months old). The same purees (carrot and green bean) were offered at 12 months while vegetables were offered at 24 months.	General information about the family including number of children, parental ages, education, employment, salary. Specific information about parents height, weight, health, and infants age, birth weight and length, mode of feeding and feeding routine. Information on maternal diet and infant's feeding behaviour also collected.	In the laboratory sessions (days 25, 26, 33 and 34), vegetable intake (carrot and green bean) was significantly higher in the IG compared with the CG (p<0.0001). Vegetable intake increased over time from the first to the second exposure. The main effect of vegetable type was highly significant with more carrot eaten than green beans (p<0.0001). Infants in the IG consumed the vegetable puree at a faster rate than the CG (p<0.01); rate of eating increased from the first to the second exposure (P<0.0001); and carrot was eaten more rapidly than green bean. Intake data recorded in the home showed a significant effect on liking and pace of eating were greater for IG than CG infants. Intake and liking of carrots were greater than green beans, however, at 6m and 18m follow up, vegetable (carrot>green beans) but not group differences were observed. Maternal ratings of liking did not differ by time, but by vegetable (p0.001), indicating that mothers reported that their infants liked carrots more than green bean. However, ratings of liking made by the investigators were significant for group (p<0.05), marginally significant for time (p=0.07), and for vegetables (p<0.001).

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures	Confounders	Findings
Lange et al, 2013	Findings from a longitudinal survey of infants' and young children's eating habits (OPALINE - Observatory of Food Preferences in Infants and Children) were used to describe maternal feeding practices in the first year (breastfeeding duration, age at introduction of solid foods, variety of new food introduced) and to investigate whether these have an impact on infants' later acceptance of new foods introduced into their diets from the beginning of complementary feeding to the age of 15 months.	France	203 infants whose mothers were recruited into the OPALINE study during the last trimester of pregnancy.	Infants' milk diets were recorded by their mothers in food diaries one week/month during the first year of life. Types of new foods offered (including description of texture, whether other ingredients such as salt and sugar had been added, whether the foods were home-made or commercially prepared) and the infants' acceptance of these foods. Information on duration of exclusive breastfeeding available.	Maternal age, education level, parity and BMI. Infant gender and caregiver during the complementary feeding period (i.e. Parents/family or daycare/nanny etc)	Duration of exclusive breastfeeding was highly variable. 16% completed between 5-6 months and 5.5% completed 180 days exclusive breastfeeding. The age at which solid foods were first introduced was: min 31 days; 1st quartile 133 days; median 158 days; 3rd quartile 179 days; max 208 days. For approximately 7% infants, complementary feeding (defined as age of introduction of the first food in a series of 5 consecutive feeding occasions with <3 days between feeding occasion) commenced before 4 months; for 74% before 6 months; and for 26% after 6 months. From the start of the complementary feeding period to 15 months of age, the majority (91%) new foods were accepted. Acceptance differed according to food category, with fruits and vegetables being the least well accepted categories at the beginning of complementary feeding. Linear regression analysis found that neither duration of exclusive breastfeeding or the age of introduction of solid foods influenced new food acceptance. The earlier vegetables were introduced the higher infants' acceptance of new vegetables was. No difference was found in new food acceptance between infants introduced to complementary foods before or after 6 months of age. New food acceptance was significantly associated with the total number of new foods (i.e. food variety) introduced during the 2 month period following the start of complementary feeding ($p<0.02$). This was particularly marked for fruit ($p<0.04$), vegetable ($p<0.002$) and meat ($p<0.02$) categories.
Maier et al, 2008	Study to investigate the effects of breast or formula feeding and experience with different levels of vegetable variety early in the complementary feeding period on new food acceptance in the 2 months following first introduction of solid foods. Infants split into 3 groups. During Phase A, all infants received the same vegetable (carrot puree - Ca) as a first meal and, over the next 9 days, group 1 received Ca every day, group 2 had 3 vegetables each given for 3 consecutive days, and group 3 had the same 3 vegetables but with daily changes. On day 11 infants were given Ca and day 12 a new vegetable, zucchini-tomato (ZT). In Phase B	Germany (Aalen) and France (Dijon)	147 mother: infant pairs. Mean age of infants at the start of the study was 5.2±0.1 months. 45 Dijon infants were breastfed for at least one month (3.9±0.2 months and 4.6±0.3 months, respectively) while 27 Dijon and 37 Aalen infants were formula-fed.	Indicators of new food acceptance were: 1) the quantities of the new foods eaten (g); and 2) liking ratings - the mother and observer rated how much they thought the infant had liked the meal using a 9 point scale.	Maternal characteristics (inc.age, BMI, parity,neophobia, anxiety traits); Infants' characteristics (inc. sex, age, weight, breastfeeding duration); Infants' temperament (difficult, unadaptable, unresponsive, unpredictable)	On day 1, intake of carrot did not differ significantly between breast and formula fed infants, or among variety groups. Breastfeeding was associated with higher intakes of the four new foods (zucchini-tomato, peas, meat and fish) ($p<0.0001$). Type of variety experience had a significant effect ($p<0.0001$) with the high vegetable variety group (group 3) producing the greatest increase in intake of new food. A significant interaction ($p<0.0009$) was observed between type of milk feeding and type of variety experience, with the combination of breastfeeding and high variety being associated with the greatest intake of new foods. The effect was still detectable up to 2 months later at the end of the intervention period. Both breastfeeding and high variety were significantly associated with higher liking scores from mothers ($p=0.005$ and $p<0.0001$, respectively) and observers ($p=0.008$ and $p<0.0001$, respectively).

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures	Confounders	Findings
	(days 13-23), infants were offered ZT and Ca on alternate days, and on day 23, were offered pea puree (Pe). Each mother decided independently when to introduce meat and fish (Phase C), so after a variable delay (21.7±1.8 days), offered the first meat puree, and after 12 days, fish puree.					
Mennella et al, 2008	Two experimental studies conducted to investigate the effects of an 8-day exposure to a particular food or a variety of foods between and/or within meals on the acceptance of fruit and vegetables in infants. ***Study 1 (fruits)***: examined the effects of repeated dietary experience with either one fruit (pear group - P) or a variety of fruits (fruit variety - FV) on infants' acceptance of pears and green beans. ***Study 2 (vegetables)***: examined how different dietary variety experiences affect the acceptance of the target vegetables. Infants split into 3 groups: green bean group fed just green beans (GB); the between-meal variety group (BM); and the between-meal and within-meal variety group (BM-WM). The latter 2 groups were fed a variety of vegetables. BM received only 1 vegetable each day (green and orange vegetables alternated daily). BM-WM received 2 vegetables each day (1 green, 1 orange).	USA	74 infants aged 4-9 months randomly assigned to 1 of 2 experimental groups: ***Study 1*** P group (*n*=20) 6.7±0.2m; FV group (n=19) 6.7+0.2m. ***Study 2*** GB group (n=11) 6.6+0.4m; BM group (n=12) 6.3+0.4m; BM-WM group (n=12) 6.4+0.4m. To be included, infants had to have at least 2 weeks experience eating cereal or fruit from a spoon and little experience with the target fruits and vegetables. Age of cereal introduction (months): Study 1 P group 3.6+0.3m; FV group 3.7+0.3m. Study 2 GB group 4.1+0.5m; BM group 4.1+0.2m; BM-WM group 3.4+0.4m.	Total intake (g), caloric intake (kcal), length (min) of each feed, rate of feeding (g/min), and mothers' rating of their infants' enjoyment of foods.	Milk feeding history (exclusively breastfed, exclusively formula fed, and breast and formula fed); age of cereal introduction (months); infant temperament measures; maternal characteristics including food neophobia.	***Study 1:*** Following 8 days of dietary exposure to pears or a variety of fruits (not including pears) between meals, a significant increase in pear consumption was observed but this was not generalisable to green beans. ***Study 2:*** Repeated exposure to a variety of vegetables between meals did not alter acceptance of green beans, carrots or spinach, but there was a tendency for increased acceptance of green beans. After 8 days of vegetable exposure, infants in the BM-WM group consumed significantly more green beans (*p*=0.0002), and carrots and spinach (*p*=0.03).

Table 8.4: Sensory properties of food – texture

Study reference	Study design	Country/setting	Participants number, gender, age, ethnicity	Outcome measures	Confounders	Findings
Blossfeld et al, 2007	To examine infants' preferences for different food textures and the key factors influencing these preferences, infants were exposed to cooked carrots prepared in two different textures; pureed and chopped. Testing was conducted in a home-setting, during the child's regular mealtime, using a cross-over design.	Ireland	70 infants aged between 48 -57 weeks (mean age: 52.7±2 weeks). 39 males, 31 females.	Intake (g) and mothers' rating of the infants' enjoyment of the different textures.	Breast and formula feeding practice, age of introduction of solid foods, avoidance of certain foods, exposure to different textures, maternal perceptions of infant's dietary variety, infant's food preferences, infant's pickiness and willingness to try new foods, infant's eating behaviour, number of teeth.	Infants consumed significantly more pureed carrots than chopped (p<0.001) and mothers' ratings of their infant's enjoyment for this texture was significantly higher (p<0.01*).* For both chopped and pureed carrots the infants' intake was highly correlated with the mothers rating of enjoyment (p<0.01and p<0.01, respectively). Familiarity with different textures, especially chopped foods, was the strongest predictor of intake and liking of chopped carrots. Furthermore, infants with higher dietary variety (p<0.05), more teeth (p<0.05) and a greater willingness to try new and unfamiliar foods (p<0.05) were more likely to consume more of the chopped carrots. Food pickiness (p<0.05) had a negative influence on the intake of, and liking for, chopped carrots.
Coulthard et al, 2009	Study to follow up children from the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC) who had been introduced to lumpy solids at different ages and assess their dietary intake and feeding difficulties at 7 years of age. Data collected from self-report questionnaires completed by the mother about her child at 6 months, 15 months and 7 years postpartum about foods eaten and feeding difficulties. Children divided into 3 groups based on the age at which 'lumpy' solids were first introduced: solids introduced <6 months (n=946, 12.1%); solids introduced between 6-9 months (n=5457, 69.8%); and solids introduced >9 months (n=1418, 18.1%).	UK	7821 children aged 7 yrs whose mothers were recruited when pregnant as part of the ALSPAC.	Age of introduction of lumpy foods. Mothers asked to rate five potential feeding difficulties: 1) not eating sufficient amounts; 2) refusal to eat the right food; 3) being choosy with food; 4) over-eating; and 5) being difficult to get into a feeding routine. Mothers also completed questionnaires on their 7 yr olds present consumption of a list of 67 food and 8 drink categories.	Sex of infant, number of older siblings, maternal education, mother's age at birth of her child, whether she had a partner, and housing tenure. Age at which the child's first tooth erupted and duration of breastfeeding also considered.	At 7 years of age, children introduced to lumps after 9 months ate less of many of the food groups at 7 years, including all 10 categories of fruit and vegetables, than those introduced to lumpy food between 6-9 months (p<0.05-0.001). This group were also reported as having significantly more feeding problems at 7 yrs old (p<0.05-0.001). These included not eating sufficient amounts, refusal to eat the right amount and being choosy with food.

Study reference	Study design	Country/setting	**Participants** number, gender, age, ethnicity	Outcome measures	Confounders	Findings
Northstone et al, 2001	Using information collected as part of the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC), to investigate the effect of age of introduction of lumpy solids on foods eaten and reported feeding difficulties at 6 and 15 months of age. Infants divided into 3 groups based on the age at which lumpy solids were first introduced; 10.7% < 6m; 71.7% between 6-9m; and 17.6% after 10m of age. Information about dietary patterns of the infants and any difficulties experienced by the mothers in feeding her child collected by self-completion questionnaires at 6m and 15m.	UK	9360 mothers of infants born in 1991/1992, as part of ALSPAC. Multiple births and ethnic minorities were excluded from the analysis.	The 15m questionnaire asked 'When did you child first start having meals with "lumps" in?'. Mothers asked whether their infant had been given any of a list of foods and if so, at what age this was introduced and the current frequency of consumption. Mothers asked about any difficulties they experienced in feeding their child, and about feeding behaviours and current feeding skills of their infant.	Sex of infant, number of older siblings, maternal education, mother's age at birth of her child, whether she had a partner, and housing tenure. Age at which the child's first tooth erupted and duration of breastfeeding also considered.	Compared to infants introduced to lumpy solids between 6-9m, infants introduced to lumpy solids before six months consumed at greater variety of family foods at 6m, while those introduced at 10m or later had been given fewer solids of all types by six months of age, and at 15m were less likely to be having family foods.

Chapter 9. Oral health: annex table

Table 9.1 Oral health: systematic reviews and meta-analyses

Study reference	Study design	Country/setting and participants	Definition of exBF and/or complementary feeding/weaning	Outcome measures	Confounders	Findings
Avila et al,**.** 2015	The aim of this study was to systematically review the scientific evidence relating to the association between feeding practice (breastfeeding vs. bottle feeding) and dental caries in childhood. Seven studies were included in this systematic review (two in meta-analysis): five cross-sectional, one case-control, and one cohort. Statistical data could be: odds ratio (OR), relative risk (RR), prevalence ratio (PR), confidence intervals (95%CI), p-values, or studies that reported frequency or an absolute number of events/total number of individuals per group.	Children with exclusively primary dentition. Three studies recruited children from kindergartens, and four recruited children from hospital and health centre's. The age of patients ranged from 18 months to 60 months. The sample size of the studies ranged from 218 to 2395 children. Only two studies used a representative sample and both collected the sample from kindergartens, one in one of the largest cities in Syria and the other in two provinces of China. Studies were also carried out in Kuwait, Sril Lanka, South Africa and Italy.	All studies considered categorical data regarding the presence and absence of breastfeeding, bottle feeding or mixed feeding, although the criteria used to define types of feeding differed between studies. One author considered breast feeding or bottle feeding at birth [36]; two authors considered feeding habits up to 6 months or more [11, 15], one author considered exclusive breastfeeding up to 12 months [10], and others considered feeding habits during infancy [12, 16, 37].	Dental caries	Cross-sectional studies: Social class; Case-control study: social class, age, gender, race; Cohort study: social class (but in respect to severity of dental caries). Note: none of the studies were adjusted for all the confounding factors, all are susceptible to residual confounding. Confounding variables can include social class, hygiene and sugar in bottle content, ethnicity, early preventive dental visits, water fluoridation and on-demand feeding at night.	A meta-analysis of cross-sectional studies showed that breastfed children were less affected by dental caries than bottle fed children (OR: 0.43; 95%CI: 0.23–0.80). Four studies showed that bottle fed children had more dental caries (p<0.05), while three studies found no such association (p>0.05). The scientific evidence therefore indicated that breastfeeding can protect against dental caries in early childhood.
Peres et al., 2015	Systematic review and meta-analysis to investigate whether breastfeeding decreases the risk of malocclusions. 48 studies were included and of these, 41 presented data for at least one meta-analysis.		**Categorisation of breastfeeding:** 1. Ever breastfeeding versus never breastfeeding: In this category, we pooled studies that compared subjects who were ever breastfed with subjects who were never breastfed. 2. Exclusive breastfeeding versus absence of exclusive breastfeeding: In this category, we combined all studies that provided information about exclusive breastfeeding independently of its duration compared with the absence of exclusive breastfeeding. 3. Breastfeeding for long periods versus breastfeeding for short periods: All studies that compared longer with shorter periods of breastfeeding were considered.	All kinds of malocclusion; such as nonspecific malocclusion, anterior open bite, posterior cross-bite, overbite, overjet.		Results revealed that participants ever exposed to any type of breastfeeding were less likely to develop malocclusions than those never breastfed [OR 0.34 (95%CI 0.24–0.48)]. Participants who were exclusively breastfed for a period of time were less likely to develop a malocclusion [OR 0.54 (95%CI 0.38–0.77)] compared to those who were not exclusively breastfed. Individuals who were breastfed for longer periods were 60% less likely to develop malocclusions compared to those who were breastfed for shorter periods [OR 0.40(95%CI 0.29–0.54)]. Authors concluded that breastfeeding decreases the risk of malocclusions.

Study reference	Study design	Country/setting and participants	Definition of exBF and/or complementary feeding/weaning	Outcome measures	Confounders	Findings
Tham et al, 2015	Systematic review, meta-analysis and narrative synthesis on the associations between breastfeeding and dental caries, with respect to specific windows of early childhood caries risk. 63 papers included (14 cohorts; 6 of these were nested within RCTSs of breastfeeding promotion interventions, 3 case-controls, 46 cross-sectional). Majority of studies (n = 46) were not included in the meta-analyses due to methodological differences in the measures of exposure and outcomes, or reporting of correlational analyses only.	Children and adolescents from both general and high-risk populations (e.g. low socioeconomic communities).Studies were predominantly conducted in high and middle income countries (Brazil, USA, Belarus, Finland, UK, Japan, Thailand, Burma, India, Tanzania, South Africa, Italy, Phillipines, Kuwait, China, Nigeria, Sweden, Australia, Bangladesh, Greece, Canada, Singapore, Israel, Uganda, Sri Lanka, Syrial, Jordan, Lithuania, DRC,) with only eight studies from low income countries.	In the assessment for meta-analysis, exposure to breastfeeding assessed in two specific time windows: (i) Up to 12 months of age (upper and lower incisors present) and (ii) Beyond 12 months of age (other teeth erupting up to 33 months- increased risk of caries). As there were very few mothers who exclusively breastfed infants until 12 months or beyond, within these time windows studies were categorized into: (i) Never breastfed compared to any breastfeeding and (ii) More versus less breastfeeding. This category was created to include all studies, which compared groups with relatively more (longer duration of breastfeeding) and relatively less breast milk exposure (shorter duration).	Development of dental caries in deciduous or permanent teeth.	Socio-economic status, age, mother's educational level, number of teeth, and exposure to sugar in the diet (food or other liquid).	Children exposed to longer versus shorter duration of breastfeeding up to age 12 months (more versus less breastfeeding), had a reduced risk of caries (OR 0.50; 95%CI 0.25, 0.99, I2 86.8%). Children breastfed >12 months had an increased risk of caries when compared with children breastfed <12 months (seven studies (OR 1.99; 1.35, 2.95, I2 69.3%). Amongst children breastfed >12 months, those fed nocturnally or more frequently had a further increased caries risk (five studies, OR 7.14; 3.14, 16.23, I2 77.1%). There was a lack of studies on children aged >12 months simultaneously assessing caries risk in breastfed, bottle-fed and children not bottle or breastfed, alongside specific breastfeeding practices, consuming sweet drinks and foods, and oral hygiene practices limiting the authors 'ability to tease out the risks attributable to each.

Table 9.2: Oral health: cohort studies

Study reference	Study design	Country/setting and participants	Definition of exBF and/or complementary feeding/weaning	Outcome measures	Confounders	Findings
Behrendt et al, 2001	Retrospective study covering the period from 01 /01/1998 to 31/12/1998	Germany. 186 children, eighty-five girls (45.7 percent) and 101 boys (54.3 percent), with carious primary teeth typical of nursing bottle syndrome. The average age was 41.2 months.	Prolonged use of nursing bottles beyond the first year of age. • Prolonged use of vessels with bill-shaped extensions beyond the first year of age. •Use of pacifiers dipped in sugary substances. • Prolonged and excessive breast-feeding beyond the first year of age.	Nursing bottle syndrome? Dental caries?		In spite of varying numbers of patients in each group, it has become evident that the different forms of "sucking-nutrition" caused similar damage to the teeth. The dmf(t) values ranged between 8.3 and 11.4. There were no significant differences between dmf(t) values of any of the groups (p=0.41). It is also notable that hardly any child had had teeth restored (i.e. f(t)=0.1-0.2).
Feldens et al, 2010	Prospective cohort study to investigate feeding practices in the first year of life associated with severe early childhood caries (S-ECC) at the age of 4 years. Socioeconomic factors and hygiene practices were also assessed, given the possibility of confounding the association between feeding practices and S-ECC.	Study was part of a randomized trial which recruited 500 infants at birth (apparently normal, single, full-term (≥ 37weeks) with normal birth weight (≥ 2,500 g)) in São Leopoldo, southern Brazil.	The following feeding practices were investigated: night time bottle use, bottle use for drinks other than milk, frequency of breastfeeding, high frequency of daily meals/snacks, high density of sugar, high density of lipids and among those who do not eat family meals at 12 months.	Dental caries	Socioeconomic factors (mother's education, mother's and father's occupation status and family income) and hygiene practices	The multivariable model showed a higher adjusted risk of S-ECC for the following dietary practices at 12 months: breastfeeding 6 7 times daily (RR = 1.97; 95% CI = 1.45–2.68), high density of sugar (RR =1.43; 95% CI = 1.08–1.89), bottle use for liquids other than milk (RR = 1.41; 95% CI =1.08–1.86), as well as number of meals and snacks 1 8 (RR = 1.42; 95% CI = 1.02–1.97). Mother's education ≤8 years was also associated with the outcome.
Hong et al, 2014	Cohort study to assess the longitudinal effects of breast-feeding duration on caries experience at five years old and nine years old.	All children were participants in the IFS which is a longitudinal study of the relationships among fluoride exposures, biological and environmental factors, and children's dental health. A total of 1,390 newborns recruited (at birth) from March 1992 to February 1995 from eight Iowa hospitals participated in the study.	Information regarding breast-feeding, formula use, beverage intakes, general health/illnesses, and oral health behaviours was also obtained. Fluoride intake in mg per day was estimated from water, formula, other beverages, selected foods, dietary fluoride supplements, and fluoride dentifrice, based on parents' responses to a series of questions.	Dental caries	Birth weight, parental education level, enamel hypoplasia, soda pop intake, home water fluoride level	For primary second molars at five years old, 18 percent of children who were breast-fed less than six months had caries (mean dfs=0.55) while only 9 percent of children who were breast-fed at least six months had caries (mean dfs=0.33). From five to nine years old, caries incidence was 32 percent and 31 percent, respectively, for children breast-fed less than six months and at least six months. In multivariable regression analyses, shorter breast-feeding duration was positively associated with caries experience of primary second molars at five years old (P=.005), both before and after controlling for other important factors. Note: However, our study did not differentiate between cavitated

Study reference	Study design	Country/setting and participants	Definition of exBF and/or complementary feeding/weaning	Outcome measures	Confounders	Findings
						enamel (d2) and dentin (d3) lesions. For this report, caries experience was considered in two ways. First, caries experience (yes/ no) was defined based on whether a subject had any decayed (cavitated d2-3 lesions) and/or filled surfaces on primary second molars. Second, the number of decayed (cavitated d2-3 lesions) and/or filled surfaces was counted (dfs).
Majorana et al, 2014	Retrospective study- questionnaire and clinical examination.	Italy- City of Brescia. Mothers attending the two abstetric wards of Brescia Hospital between May 2008 and April 2009. n=2395 toddlers, aged 24-30 months, enrolled between May 2008 and April 2009. clinical examination of children took place May 2010- October 2010	Feeding practices were classified using cut-off points for the percentages of breast milk and formula administered to the infant at each meal.	Feeding practices, sweet dietary habit, maternal smoking habit, SES, and fluoride supplementation; Caries lesions	SES, smoking (maternal and environmental)	Caries prevalence and severity levels were significantly lower in toddlers who were exclusively breastfed and those who received low mixed feeding with a moderate-high breast milk component, compared with toddlers who received low mixed feeding and those exclusive fed with formula (p<0.01). 80.84% of toddlers had caries present; 48.60% had low caries severity level, 27.52% had moderate caries severity level, and 4.30% had high caries severity. ICDAS score (caries severity level) were significantly lower in children who received higher proportions of breast milk (exclusive breastfeeding, moderate-high mixed feeding) than in those who received lower proportions (low mixed feeding, exclusively infant formula) at 6 months of age p<0.01. High sweet beverage intake by children was highly statistically significant associated to smoking habit.

Table 9.3: Oral health: cross-sectional studies

Study reference	Study design	Country/setting and participants	Definition of exBF and/or complementary feeding/weaning	Outcome measures	Confounders	Findings
Du et al, 2000	Cross-sectional survey to describe the prevalence, severity and patterns of caries in 2-4-year-old children and to evaluate the association between caries experience of the children and their feeding patterns and socio-economic background in terms of mothers' education and family income.	A convenience sample was used for the study consisting of children aged between 24 and 47 months attending kindergartens in one suburban area of Hanchuan in Hubei province, China. A sample of 426 children (250 boys and 176 girls).	Method of feeding categories: wholly bottle-fed, wholly or partly breast-fed.	Prevalence of caries; rampant caries; caries in incisors; caries in incisors and/or canines and molars; mean number of decayed, missing and filled teeth surfaces (dmft/s)	gender, age, mothers' education, family income and feeding patterns	Method of feeding showed a statistically significant association with rampant caries (P<O.Ol) and incisor caries (R0.05), with a higher prevalence in children who were bottle-fed. The following variables were entered into multiple logistic regression analysis: gender, age, mothers' education, family income and feeding patterns, with presence of caries and of rampant caries, incisor caries and caries in molars and incisors as dependant variables. Stepwise multiple logistic regression showed that when account was taken of others factors, feeding patterns were significant in relation to rampant caries and to incisor caries. Children who had been wholly bottle-fed had five times the risk of having rampant caries compared to children who were breast-fed.
Qadri et al, 2012	Cross-sectional cohort survey to determine the prevalence and severity of early childhood caries (ECC) in pre-school children aged 3-5 years in Syria as well as assess its association with different feeding practices.	Latakia is one of the largest Syrian cities, located 348km northwest of Damascus, with a population of approximately 554,000. Drinking water supplies of the city have natural fluoride level of 0.12ppm. 400 children (209 girls, 191 boys) aged 3-5 years were selected randomly from 20 different kindergartens	predominantly breastfeeding, bottlefed	Early childhood caries	Age, sex, dietary practices (bottle vs breastfeeding)	Of the 400 children examined, 70.0% had carious defects, 36.2% had restorations and 25.7% had had extractions. 72.3% of all boys and 69.9% of all girls were found with carious defects but this difference was not significant (p=0.787). Regarding ECC, 192 children of the total sample were diagnosed with ECC, with a prevalence rate of 48%. The number of children with a healthy dentition clearly decrease with age, while the severity of the lesions increased. Caries levels were significantly higher in the children who were bottlefed than in children who were predominantly breastfed (p<0.001). There was an increase in the mean dmft in the children who were mostly bottlefed compared with children who were not. The number of teeth affected was also significantly higher in predominantly bottlefed children with ECC compared with children who were breastfed (Z-statistic -2.1, p=0.036). On basic logistic regression models, (crude) dietary practices and age variables were significantly related to dmft and ECC respectively (p=0.048, p<0.001). Age had the strongest and most consistent relationship with all outcomes.

Chapter 10. UK infant feeding practice: annex tables

Table 10.1: Incidence of breastfeeding by country (UK, 1980-2010)

	1980	1985	1990	1995	2000	2005	2010
% who breastfed initially	%	%	%	%	%	%	%
United Kingdom	-	-	62	66	69	76	81
England	-	-	-	-	-	78	83
Wales	-	-	-	-	-	67	71
England & Wales	67	65	64	68	71	77	82
Scotland	50	48	50	55	63	70	74
Northern Ireland	-	-	36	45	54	63	64
Unweighted bases: All Stage 1 mothers[1]							
United Kingdom	*n/a*	*n/a*	*n/a*	*9130*	*9492*	*12290*	*15724*
England	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*6075*	*7336*
Wales	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*2135*	*2633*
England & Wales	*n/a*	*n/a*	*n/a*	*n/a*	*5440*	*8210*	*9969*
Scotland	*n/a*	*n/a*	*n/a*	*n/a*	*2274*	*2194*	*3107*
Northern Ireland	*n/a*	*n/a*	*n/a*	*n/a*	*1778*	*1886*	*2648*
Weighted bases: All Stage 1 mothers							
United Kingdom	*n/a*	*n/a*	*5533*	*5181*[2]	*9492*	*12290*	*15722*
England	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*6075*	*7335*
Wales	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*2135*	*2633*
England & Wales	*3755*	*4671*	*4942*	*4598*	*5441*	*8210*	*9959*
Scotland	*1718*	*1895*	*1981*	*1863*	*2274*	*2194*	*3108*
Northern Ireland	*n/a*	*n/a*	*1497*	*1476*	*1778*	*1886*	*2650*

1Unweighted bases for previous years were not available at the time of publication

2There are large differences between the unweighted and weighted bases for 1995. This is because in 1995 bases were scaled to a single base, regardless of which stage the data related to.

Table 10.2: Estimated incidence of breastfeeding standardised[1] by the composition of the sample by country (UK, 2005 and 2010)[2]

	1985	1990	1995	2000	2005	2010
% who breastfed initially	%	%	%	%	%	%
England & Wales						
Unstandardised percentage	65	64	68	71	77	82
Standardised percentage	65	62	62	62	67	72
Scotland						
Unstandardised percentage	48	50	55	63	70	74
Standardised percentage	48	46	48	54	57	60 [3]
Northern Ireland						
Unstandardised percentage	-	36	45	54	63	64
Standardised percentage	-	36	41	47	51	51

[1]Standardised for mother's age and age finished full-time education

[2]1985 is the base year for standardisation for England, Wales and Scotland whereas the year used for Northern Ireland is 1990

[3]In the 2010 IFS Early Results report, a rounding error meant that the standardised figure for Scotland (60%) was reported incorrectly in the text and table so it appeared (wrongly) that the increase in incidence in Scotland was largely due to changes in sample composition.

Table 10.3: Prevalence of breastfeeding at ages up to nine months by country (UK, 1995 - 2010)

Base: All Stage 3 mothers[1]

	Total				Country							
					England		Wales		Scotland		Northern Ireland	
	1995[3]	2000	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010
	%	%	%	%	%	%	%	%	%	%	%	%
Birth	66	69	76	81	78	83	68	71	71	74	62	64
2 days	n/a	n/a	72	76	74	78	63	64	66	69	57	57
3 days	n/a	n/a	70	74	72	76	59	61	63	67	54	53
4 days	n/a	n/a	67	72	70	75	56	58	61	64	50	51
5 days	n/a	n/a	66	71	68	73	55	57	59	63	49	49
6 days	n/a	n/a	64	70	66	72	53	55	58	62	47	48
1 week	56	55	63	69	66	72	52	55	57	61	46	47
2 weeks	53	52	60	66	62	68	48	51	54	58	44	44
6 weeks	42	42	48	55	50	57	37	40	44	50	32	33
4 months	27	28	34	42	35	44	24	29	31	39	20	22
6 months	21	21	25	34	26	36	18	23	24	32	14	16
9 months[2]	14	13	18	23	19	24	12	18	15	21	10	9
Unweighted bases	*7198*	*7267*	*9416*	*10768*	*4563*	*4935*	*1582*	*1804*	*1666*	*2119*	*1605*	*1910*
Weighted bases	*5181*[4]	*7267*	*9416*	*10769*	*4563*	*4935*	*1582*	*1804*	*1666*	*2119*	*1605*	*1908*

[1]It should be noted that the analysis on the prevalence of breastfeeding is based on all mothers who completed Stage 3 of the survey, while incidence of breastfeeding is based on all mothers who completed Stage 1 of the survey. This means there are some small differences in the estimates reported in section 1.1 about incidence of breastfeeding compared with the prevalence of breastfeeding at birth reported in section 1.2.

[2]Based on a reduced number of bases excluding those infants who had not reached 9 months by Stage 3

[3]The unweighted base for 1995 was not available at the time of publication

[4]There are large differences between the unweighted and weighted bases for 1995. This is because in 1995 bases were scaled to a single base, regardless of which stage the data related to.

Table 10.4: Reasons given by mothers for stopping breastfeeding within one or two weeks (UK, 2005 and 2010)[1]

Base: All Stage 1 mothers who stopped breastfeeding within first two weeks who gave birth in hospital, birth centre or unit

	Infant's age when breastfeeding ceased			
	Less than 1 week		1 week, but less than 2 weeks	
	2005	2010	2005	2010
	%	%	%	%
Infant would not suck / rejected breast	35	33	24	22
Painful breast / nipples	24	22	30	21
Insufficient milk	25	17	42	28
Infant too demanding / always hungry[2]	n/a	11	n/a	17
Inconvenient / formula is more convenient	1	11	1	11
Found breastfeeding difficult / exhausting[3]	3	9	2	8
Had little / no support	5	8	4	5
Domestic reasons (coping with other relatives / children)	4	6	7	7
(Too) stressful/causing distress	7	6	8	8
Breastfeeding took too long / was tiring	10	5	17	6
Unweighted bases	*1497*	*1726*	*412*	*525*
Weighted bases	*1428*	*1514*	*435*	*532*

[1]This covers the top ten reasons given by mothers who stopped breastfeeding (more than one reason could be provided)
[2]New code in 2010
[3]'Exhausting' added in 2010

Table 10.5: Whether mothers who initially breastfed would have liked to have breastfed for longer (UK, 2010)

Base: All Stage 1 mothers who stopped breastfeeding within first two weeks who gave birth in hospital, birth centre or unit		
	Infant's age when breastfeeding ceased	
	Less than 1 week	**1 week, but less than 2 weeks**
	%	%
I would have liked to breastfeed for longer	80	85
I breastfed for as long as I intended	14	9
I breastfed for longer than I intended	3	3
Unweighted bases	*1726*	*525*
Weighted bases	*1514*	*532*

Table 10.6: Prevalence of exclusive breastfeeding at ages up to six months by country (UK, 2005 and 2010)

Base: All Stage 3 mothers

	Total UK		Country							
			England		Wales		Scotland		Northern Ireland	
	2005	**2010**	**2005**	**2010**	**2005**	**2010**	**2005**	**2010**	**2005**	**2010**
	%	%	%	%	%	%	%	%	%	%
Birth	65	69	66	71	58	57	61	63	55	52
1 week	45	46	46	47	38	36	42	40	35	33
2 weeks	38	40	39	41	32	32	37	35	31	27
3 weeks	33	35	34	36	28	28	32	32	25	23
4 weeks	28	30	29	31	21	23	25	28	20	19
6 weeks	21	23	22	24	15	17	19	22	13	13
2 months (8 weeks)	18	21	18	21	12	15	17	20	11	12
3 months (13 weeks)	13	17	14	18	9	13	12	17	8	9
4 months (17 weeks)	7	12	8	13	4	9	6	12	4	6
5 months (21 weeks)	3	5	3	5	2	3	3	5	2	3
6 months (26 weeks)	*	1	*	1	*	*	*	1	*	1
Unweighted bases	*9416*	*10768*	*4563*	*4935*	*1582*	*1804*	*1666*	*2119*	*1605*	*1910*
Weighted bases	*9416*	*10769*	*4563*	*4935*	*1582*	*1804*	*1666*	*2119*	*1605*	*1908*

Table 10.7: Duration of exclusive breastfeeding among mothers who fed exclusively at birth by how exclusive breastfeeding status was lost (UK, 2005 and 2010)

Base: All Stage 3 mothers who fed exclusively at birth

		How exclusive feeding status was lost				
	All mothers who fed exclusively at birth	Formula	Other liquids	Formula / Other liquids	Solids	Solids and other combination
	%	%	%	%	%	%
Birth	100	100	100	100	100	100
1 week	66	55	89	60	100	100
2 weeks	58	45	74	49	100	99
3 weeks	51	37	65	39	100	99
4 weeks	44	28	55	31	99	99
6 weeks	34	17	37	17	95	99
2 months (8 weeks)	30	13	28	15	94	99
3 months (13 weeks)	25	7	19	11	94	98
4 months (17 weeks)	18	1	9	5	79	89
5 months (21 weeks)	7	*	2	2	37	30
6 months (26 weeks)	1	*	*	*	3	7
Unweighted bases	*7397*	*4672*	*676*	*458*	*821*	*631*
Weighted bases	*7437*	*4588*	*777*	*513*	*740*	*660*

Table 10.8: Age at which milk other than breastmilk[1] was first introduced by mother's age and socio-economic classification (NS-SEC) (UK, 2005 and 2010)

Base: All Stage 3 mothers

	Total		Age of Mother					NS SEC				
	2005	2010	Under 20	20-24	25-29	30-34	35 or over	Managerial & professional	Intermediate occupations	Routine & manual occupations	Never worked	Not classified
	%	%	%	%	%	%	%	%	%	%	%	%
Percentage of mothers who had given milk other than breastmilk by:												
Birth	35	31	54	45	28	24	24	20	30	39	46	32
1 week	54	52	71	66	50	45	46	42	51	61	64	54
4 weeks	69	66	82	80	65	61	59	57	67	75	73	68
6 weeks	76	73	84	85	71	68	67	65	73	81	77	74
2 months	79	75	87	87	73	70	70	67	76	82	80	76
4 months	88	83	90	91	82	79	80	78	83	88	85	83
6 months	92	88	95	94	87	86	86	85	90	92	89	87
9 months[1]	96	95	100	97	95	94	94	94	96	96	95	94
Unweighted bases	*9416*	*10768*	*273*	*1204*	*2850*	*3783*	*2632*	*4696*	*2248*	*2438*	*567*	*819*
Weighted bases	*9416*	*10769*	*585*	*2001*	*3002*	*3050*	*2083*	*3747*	*2105*	*2880*	*1055*	*982*

[1]At each stage of the survey mothers were asked at what age they had first given their baby any sort of milk other than breastmilk. It is not possible from the information collected in the survey to be sure of the exact type of milk other than breastmilk that mothers first gave to their baby, although in the majority of cases it can be assumed that it was infant formula.

Table 10.9: Cow's milk given at Stages 2 and 3 by country (UK, 2005 and 2010)

Base: All Stage 2 and 3 mothers

	Stage 2		Stage 3		Country							
	Total		Total		England		Wales		Scotland		Northern Ireland	
	2005	2010	2005	2010	Stage 2	Stage 3	Stage 2	Stage 3	Stage 2	Stage 3	Stage 2	Stage 3
	%	%	%	%	%	%	%	%	%	%	%	%
As main milk	1	*	6	4	*	4	1	3	*	3	1	4
Whole	1	*	5	3	*	3	*	3	*	2	1	3
Semi-skimmed	*	*	1	*	*	1	*	*	*	*	*	1
Skimmed	*	*	*	*	0	*	*	0	0	*	*	0
As an occasional drink	1	3	19	24	3	24	3	26	3	21	4	28
To mix food	2	2	23	29	2	29	2	30	1	28	3	32
All using cows' milk	**2**	**4**	**39**	**42**	**4**	**42**	**5**	**42**	**3**	**37**	**5**	**44**
Unweighted bases	*10814*	*10768*	*9416*	*10768*	*5721*	*4935*	*2138*	*1804*	*2534*	*2119*	*2172*	*1910*
Weighted bases	*10814*	*10769*	*9416*	*10769*	*5721*	*4935*	*2138*	*1804*	*2534*	*2119*	*2171*	*1908*

Table 10.10: Age by which solid foods had been introduced by country (UK, 2005 and 2010)

Base: All Stage 3 mothers

	Total		England		Wales		Scotland		Northern Ireland	
	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010
% who had introduced solids by…	%	%	%	%	%	%	%	%	%	%
6 weeks	1	2	1	2	2	2	1	2	2	2
8 weeks	2	2	2	2	3	3	2	3	3	3
3 months (13 weeks)	10	5	9	5	13	9	13	6	11	7
4 months (17 weeks)	51	30	50	28	65	44	60	32	51	35
5 months (22 weeks)	82	75	81	75	88	83	85	74	78	75
6 months (26 weeks)	98	94	98	94	98	96	98	95	98	95
9 months (39 weeks)[1]	100	99	100	99	100	98	100	99	100	99
Unweighted bases	*9416*	*10768*	*4563*	*4935*	*1582*	*1804*	*1666*	*2119*	*1605*	*1910*
Weighted bases	*9416*	*10769*	*4563*	*4935*	*1582*	*1804*	*1666*	*2119*	*1605*	*1908*

[1]Based on a reduced number of cases excluding those infants who had not reached this age by Stage 3

Table 10.11: Why mother began giving solids when she did by age of introduction of solids (UK, 2010)

Base: All Stage 3 mothers[1]

	Total		Age at which baby first given solids				
	2005	2010	By 3 months or earlier	After 3, by 4 months	After 4, by 5 months	After 5, by 6 months	After 6 months
	%	%	%	%	%	%	%
Baby not satisfied with milk	63	52	64	64	56	31	31
Experience from previous baby	32	30	27	30	29	31	38
Baby able to sit up and hold food in hand[2]	n/a	29	15	22	31	35	37
On advice from health visitor/other health professional	35	27	20	23	25	35	31
Baby waking during the night[3]	1	26	23	30	29	18	16
On advice from friends/relatives	15	17	20	21	16	12	19
Leaflets/written information	14	13	9	8	10	24	25
Baby not gaining enough weight	6	5	5	5	6	5	7
Baby was interested in mother's/other people's food	1	5	2	3	5	5	5
Other reason	6	7	6	7	6	11	11
Unweighted bases	*9416*	*10768*	*535*	*2576*	*4816*	*2261*	*453*
Weighted bases	*9416*	*10769*	*575*	*2607*	*4888*	*2088*	*464*

[1]Base includes mothers who had not yet introduced solids at Stage 3

[2]Option not included on prompted list in 2005

[3]Option not included on prompted list in 2005, but a small proportion of mothers mentioned it spontaneously

Table 10.12: Frequency with which mothers gave different types of food at Stage 3 of the survey (UK, 2010)

Base: All Stage 3 mothers[1, 2]

	Frequency		
	At least once a day	1-6 times a week	Less than once a week or never
Fresh foods (such as fruit, vegetables, home-made foods)	87	10	3
Fruit	81	15	5
Vegetables	80	14	5
Breakfast cereals	80	10	10
Cheese, yoghurt, fromage frais	68	21	11
Bought ready-made foods (such as jars)	41	26	33
Puddings or desserts	32	25	43
Bread	27	41	31
Butter/margarine and other spreads	18	28	54
Rice or pasta	17	59	24
Potatoes	17	65	18
Biscuits, sweets, chocolate or cakes	11	24	64
Crisps and corn snacks	10	26	64
Chicken/other poultry	7	72	21
Beans, lentils and chickpeas	3	37	59
Beef	3	51	46
Fish	3	53	44
Potato products	3	13	84
Tofu, quorn, textured vegetable protein	3	7	91
Lamb	2	30	67
Pork	2	31	67
Eggs	2	25	73
Nuts	*	2	98

[1]The small number of mothers who had not introduced their baby to solids by Stage 3 are treated as never having introduced these foods.
[2]This table combines several questions asking about the frequency of giving different types of food and the data for each type of food are presented horizontally. The base for each type of food is all Stage 3 mothers (10768 unweighted; 10769 weighted)

Table 10.13: Proportion of infants who were given vitamin drops (2005 and 2010)

Base: All mothers at each stage of the survey	Total	
	2005	2010
% of infants who were given vitamin drops at:	%	%
Stage 1 (4-10 weeks)	3	7
Stage 2 (4-6 months)	4	9
Stage 3 (8-10 months)	7	14
Stage 1 mothers (unweighted bases)	*12290*	*15724*
Stage 2 mothers (unweighted bases)	*10814*	*12565*
Stage 3 mothers (unweighted bases)	*9416*	*10768*
Stage 1 mothers (weighted bases)	*12290*	*15722*
Stage 2 mothers (weighted bases)	*10814*	*12568*
Stage 3 mothers (weighted bases)	*9416*	*10769*

Table 10.14: Percentage contribution to average daily energy intake

	4-6 months	7-9 months	10-11 months	12-18 months
	%	%	%	%
Infant formula	51	39	31	10
Breast milk	18	8	4	2
Commercial infant foods	16	17	14	6
Cereals/cereal products	3	10	15	24
Milk/milk products	4	9	13	27
Meat/meat products	1	4	6	8
Vegetables/pulses	3	4	5	7
Fish/fish dishes	0	1	2	2
Fruit	3	4	4	6

Table 10.15: Proportion of participants with average daily intake of vitamins from all sources (including dietary supplements) below the Lower Reference Nutrient Intake (LRNI), by age at Stage 1

Vitamin	Age group (months)			
	4-6	**7-9**	**10-11**	**12-18**
	%	%	%	%
Vitamin A	0	0	0	2
Thiamin	0	0	0	0
Riboflavin	0	0	0	0
Niacin equivalents	0	0	0	0
Vitamin B_6	8	1	1	0
Vitamin B_{12}	5	1	0	0
Folate	0	0	0	0
Vitamin C	0	0	0	0
Bases (unweighted)	*329*	*630*	*449*	*1275*

Table 10.16: Average daily intake of vitamins from all sources (including dietary supplements) as a percentage of Reference Nutrient Intake (RNI), by age at Stage 1

Vitamin		Age group (months)			
		4-6	7-9	10-11	12-18
		%	%	%	%
Vitamin A	Mean	272	283	270	175
	Median	246	262	250	152
	sd	119	128	135	94
Thiamin	Mean	313	330	324	223
	Median	294	318	314	214
	sd	109	81	78	61
Riboflavin	Mean	221	253	284	249
	Median	227	249	276	243
	sd	79	78	95	88
Niacin equivalents	Mean	184	217	233	258
	Median	183	214	229	253
	sd	52	53	55	53
Vitamin B_6	Mean	336	281	214	202
	Median	248	250	197	193
	sd	253	132	89	63
Vitamin B_{12}	Mean	521	504	625	732
	Median	533	475	576	713
	sd	279	239	291	335
Folate	Mean	218	250	273	206
	Median	214	246	261	204
	sd	73	71	78	58
Vitamin C	Mean	304	310	295	208
	Median	305	301	290	185
	sd	97	101	113	115
Vitamin D non-breastfed[1]	Mean	117	127	111	55
	Median	115	126	111	27
	sd	34	44	50	55
Vitamin D breastfed excluding breast milk[2]	Mean	41	52	54	37
	Median	27	44	45	21
	sd	44	39	51	40
Bases (unweighted)		*329*	*630*	*449*	*1275*

[1]Vitamin D intake does not include values for breastfed children as the vitamin D content of breast milk is not known. The bases are: 240 for 4-6M, 489 for 7-9M, 381 for 10-11M and 1177 for 12-18M. Note breastfeeding status is defined by whether it was recorded in the four-day diary.

[2]Vitamin D intake includes values for breastfed children excluding the contribution from breast milk (therefore excluding any exclusively breastfed children (n=2)) as the vitamin D content of breast milk is not known. The bases are 89 for 4-6M, 141 for 7-9M, 68 for 10-11M and 98 for 12-18M. Note breastfeeding status is defined by whether it was recorded in the four-day diary.

Table 10.17: Average daily intake of minerals from all sources (including dietary supplements) as a percentage of Reference Nutrient Intake (RNI), by age at Stage 1

Mineral		Age group (months)			
		4-6	7-9	10-11	12-18
		%	%	%	%
Iron	Mean	135	94	98	93
	Median	131	95	97	88
	sd	66	35	37	39
Calcium	Mean	98	109	122	226
	Median	95	108	118	221
	sd	30	31	38	74
Magnesium	Mean	115	124	136	159
	Median	107	119	133	157
	sd	42	36	39	43
Potassium	Mean	106	159	180	200
	Median	101	154	174	199
	sd	34	43	53	55
Zinc	Mean	118	104	107	109
	Median	116	102	103	106
	sd	34	28	32	32
Copper	Mean	142	165	173	126
	Median	136	159	168	122
	sd	44	55	61	44
Selenium	Mean	112	180	206	145
	Median	111	174	197	140
	sd	41	61	68	44
Iodine	Mean	157	171	196	248
	Median	155	162	182	234
	sd	48	60	82	114
Sodium	Mean	85	132	173	181
	Median	72	112	157	175
	sd	38	73	90	70
Bases (unweighted)		*329*	*630*	*449*	*1275*

Table 10.18: Proportion of participants with average daily intake of minerals from all sources (including dietary supplements) below the Lower Reference Nutrient Intake (LRNI), by age at Stage 1

Mineral	Age group (months)			
	4-6	7-9	10-11	12-18
	%	%	%	%
Iron	12	14	10	13
Calcium	2	1	0	0
Magnesium	10	3	2	0
Potassium	1	0	0	0
Zinc	3	3	5	4
Selenium	0	0	0	1
Iodine	0	1	0	0
Sodium	10	11	4	1
Bases (unweighted)	*329*	*630*	*449*	*1275*

Table 10.19a: Average daily sodium and salt intakes for children aged 4 to 18 months

	4-6 months	7-9 months	10-11 months	12-18 months
Average daily sodium intake (mg)	238	422	605	907
Average daily salt intake (g)	604	1072	1536	2303

Table 10.19b: Percentage contribution of food groups (food sources) to daily sodium intake (mg) for children aged between 4 and 18 months of age

	4-6 months	7-9 months	10-11 months	12-18 months
Food group	%	%	%	%
Cereals and cereal products	6	17	24	29
Milk and milk products	6	12	14	22
Commercial infant foods	16	15	10	3
Infant formula	44	25	17	5
Breast milk	16	5	2	1

Table 10.20: Mean length (cm), weight (kg), head circumference (cm) and percentage of the sample above UK-WHO growth standard percentiles[1] at Stage 1, by sex

Measurements at Stage 1	Age group (months)									
	Boys					Girls				
	All	4-6	7-9	10-11	12-18	**All**	4-6	7-9	10-11	12-18
Mean length cm	**76.5**	69.4	73.3	76.4	80.3	**75.1**	67.6	71.5	74.7	79.1
sd	**5.1**	2.7	2.8	2.9	3.6	**5.3**	3.3	3.1	2.7	3.3
> 0.4th percentile %	**100**	100	100	100	100	**100**	100	100	100	100
> 2nd percentile %	**99**	99	99	99	98	**99**	99	99	98	99
> 9th percentile %	**96**	96	97	96	94	**96**	94	95	98	96
> 25th percentile %	**87**	84	90	88	83	**89**	89	89	88	88
> 50th percentile %	**71**	66	76	77	66	**73**	72	72	77	72
> 75th percentile %	**49**	50	49	49	45	**52**	50	56	55	48
> 91st percentile %	**27**	23	35	31	22	**29**	29	30	29	27
> 98th percentile %	**14**	12	17	16	11	**11**	15	13	8	8
> 99.6th percentile %	**5**	6	6	5	5	**4**	6	4	2	4
Bases (unweighted)	***1217***	*158*	*299*	*195*	*565*	***1174***	*150*	*272*	*199*	*553*
Mean weight kg	**10.3**	8.4	9.6	10.2	11.2	**9.6**	7.8	8.6	9.4	10.6
sd	**1.5**	0.9	1.0	1.0	1.3	**1.6**	1.1	1.1	1.1	1.3
> 0.4th percentile %	**100**	100	100	100	100	**100**	100	100	100	100
> 2nd percentile %	**100**	98	100	99	100	**100**	100	99	100	100
> 9th percentile %	**98**	95	99	98	98	**98**	96	96	99	98
> 25th percentile %	**92**	89	93	95	92	**93**	89	91	90	94
> 50th percentile %	**75**	59	77	75	77	**76**	66	70	74	78
> 75th percentile %	**50**	37	52	50	51	**49**	32	41	46	55
> 91st percentile %	**26**	14	27	26	29	**22**	13	19	19	27
> 98th percentile %	**8**	4	6	7	10	**7**	4	7	5	9
> 99.6th percentile %	**3**	1	3	1	3	**1**	2	0	1	2
Bases (unweighted)	***1316***	*164*	*320*	*213*	*619*	***1264***	*154*	*285*	*216*	*609*
Mean head circumference (cm)	**46.8**	44.4	46.1	46.7	47.9	**45.6**	43.3	44.6	45.5	46.8
sd	**1.9**	1.5	1.4	1.6	1.5	**1.9**	1.4	1.4	1.4	1.4
> 0.4th percentile	**100**	100	100	100	100	**100**	100	100	100	100
> 2nd percentile	**100**	99	100	100	100	**100**	100	100	100	100
> 9th percentile	**98**	98	98	96	98	**99**	99	98	98	99
> 25th percentile	**93**	89	95	91	93	**95**	89	92	94	96
> 50th percentile	**79**	75	85	76	77	**80**	75	77	72	84
> 75th percentile	**59**	52	62	57	55	**56**	47	54	46	57
> 91st percentile	**33**	25	36	31	33	**30**	22	24	24	31
> 98th percentile	**16**	12	18	12	16	**11**	11	10	7	11
> 99.6th percentile	**5**	6	6	2	6	**4**	2	3	5	3
Bases (unweighted)	***1231***	*164*	*305*	*200*	*562*	***1191***	*152*	*282*	*210*	*547*

[1] The percentiles presented here are typical of those presented in growth charts.

Table 10.21: Iron status analytes, by age at Stage 2

		Age group (months)	
Analyte		5-11	12+
Iron Status including haemoglobin			
Ferritin (µg/l)	Mean	37.3	28.3
	Median	28.0	24.0
	sd	30.2	18.8
	Upper 2.5 percentile	127.0	79.0
	Lower 2.5 percentile	5.0	7.0
	% below reference[1, 2]	7%	11%
	Bases (unweighted)	*165*	*298*
Transferrin receptors (sTfR)(µg/ml)	Mean	6.9	8.6
	Median	6.1	6.8
	sd	3.2	5.9
	Upper 2.5 percentile	17.6	26.6
	Lower 2.5 percentile	4.3	4.2
	% above reference[3]	6%	15%
	Bases (unweighted)	*164*	*296*
Haemoglobin (g/dL)	Mean	11.5	11.7
	Median	11.5	11.7
	sd	1.1	1.0
	Upper 2.5 percentile	13.4	13.5
	Lower 2.5 percentile	9.3	9.9
	% below reference[1, 2]	13%	15%
	Bases (unweighted)	*171*	*325*
Iron deficiency anaemia	% below reference[4]	3%	2%

[1]Ferritin: 5-6M <9µg/l, 7-9M <5µg/l
Haemoglobin: 0-6M <10.5g/dL, 7-9 M <10g/dL
Scientific Advisory Committee on Nutrition (SACN). Iron and Health [Online]. London: TSO, 2010. Available: www.sacn.gov.uk/pdfs/sacn_iron_and_health_report_web.pdf

[2]Ferritin: 10M+<12µg/l
Haemoglobin: 10M+ <11g/dL
World Health Organization. Iron Deficiency Anaemia. Assessment, Prevention and Control. A guide for programme managers. 2001. Geneva: WHO, 2001.

[3]Transferrin Receptors: All ages >11µg/ml
Ramco assay (cannot be compared directly with other assays but should relate to the assay of Flowers *et al*, 1989). For infants (aged 8-15 months), the upper reference value (96% CI) for serum transferrin receptor is 13.5mg/L (Olivares *et al*, 2000).

[4]Iron deficiency anaemia was defined as those children below the lower threshold of population iron sufficiency for both age specific ferritin and haemoglobin. The base for haemoglobin has been used to calculate the percentage of children indicating iron deficiency anaemia.