A survey carried out on behalf of the Department of Health and Food Standards Agency

Diet and Nutrition Survey of Infants and Young Children, 2011

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Glossary

BIS	Bias index score
BMI	Body mass index
BTF	Blood tracking form
CASI	Computer assisted self-interview
CAPI	Computer assisted personal interview
CB	Child Benefit
CLIA	Chemiluminescence immunoassay
CO_2	Carbon dioxide
COMA	Committee on Medical Aspects of Food and Nutrition Policy
CRF	Clinical Research Facility
CRP	C-reactive protein
DAPA	Diet and Physical Activity
DH	Department of Health
df	Degrees of freedom
DEQAS	Vitamin D External Quality Assessment Scheme
DNSIYC	Diet and Nutrition Survey of Infants and Young Children
DOB	Date of birth
DRV	Dietary Reference Value
EAR	Estimated Average Requirement
EDTA	Ethylenediaminetetraacetic acid
FBC	Full Blood Count
FSA	Food Standards Agency
FTP	File transfer protocol
g	grams
g/dL	grams per decilitre
GP	General Practitioner
HMRC	Her Majesty's Revenue and Customs
HNR	Human Nutrition Research
HRP	Household Reference Person
HS	Healthy Start
IDAS	Interviewer Diary Assessment Schedule
IFS	Infant Feeding Survey
IMD	Index of Multiple Deprivation
IMS	Intrinsic and milk sugars
kcal	kilocalorie
LRNI	Lower Reference Nutrient Intake
MAFF	Ministry of Agriculture, Fisheries and Food
MJ	Megajoules
ml	millilitres
MRBIS	Mean rolling bias index score
MRC	Medical Research Council
MRC HNR	Medical Research Council Human Nutrition Research
MRVIS	Mean running variance index score

MS	Microsoft
N_2	Nitrogen
nmol/L	nanomoles per litre
NatCen	NatCen Social Research
NBA	Nutritional BioAnalysis
NDNS	National Diet and Nutrition Survey
NEQAS	National External Quality Assessment Service
NHS	National Health Service
NI	Northern Ireland
NIHR CRN	National Institute for Health Research Clinical Research Network
NISRA	Northern Ireland Statistics and Research Agency
NMES	Non-milk extrinsic sugars
NS-SEC	National Statistics Socio-economic Classification
NSP	Non-starch polysaccharides
PAL	Physical activity level
PETIA	Particle enhanced turbidimetric immunoassay
PSUs	Primary Sampling Units
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
REC	Research Ethics Committee
RLU	Relative light units
RNI	Reference Nutrient Intake
SACN	Scientific Advisory Committee on Nutrition
sd	Standard deviation
SE	Standard error
SLAP	Standard Light Antarctic Precipitation
SMOW	Standard Mean Ocean Water
TfR	Transferrin receptor
TMB	Tetramethylbenzidine
µg	micrograms
µg/l	micrograms per litre
UK	United Kingdom
WHO	World Health Organization
WTCRF	Wellcome Trust Clinical Research Facility
2H2O	Deuterium
25-OHD	25-hydroxyvitamin D

Notes to text and tables

1 Except where indicated the data used in the report have used weighting factors. The weighting factors are described in Appendix B of this report. Unweighted sample sizes are shown at the foot of each table.

2 Three different non-response weighting factors have been used: 1) for non-response at the interview stage, 2) for non-response to the clinic visit, and 3) for non-response to the stable isotope urine collections.

3 The data were analysed in SPSS version 20/21 using the complex surveys module where required.

4 The following conventions have been used in tables:

- no observations (zero value)

0 non-zero values of less than 0.5% and thus rounded to zero

[ ] used to indicate small sample bases, where the unweighted base is less than 50.

5 Because of rounding, row or column percentages may not add exactly to 100%.

6 A percentage may be quoted in the text for a single category that aggregates two or more of the percentages shown in a table. The percentage for the single category may, because of rounding, differ by one percentage point from the sum of the percentages in the table.

7 Values for means, medians, percentiles, standard deviations and standard errors are shown to an appropriate number of decimal places. For reasons of space, Standard Error may sometimes be abbreviated to SE and Standard Deviation to sd.

8 Where no result is available a missing value code has been assigned and the data are omitted from all tables and analyses. 'Missing values' occur for several reasons, including refusal or inability to answer a particular question; refusal to participate in an entire section of the survey (such as a self-completion questionnaire); cases where the question is not applicable to the participant; where a measurement has been removed as an outlier; and where a sample is invalid.

9 The group to whom each table refers is stated at the upper left corner of the table.

10 In Chapters 3 and 5 some comparisons by age have been statistically tested at the 95% significance level; only significant differences are highlighted in the text. No statistical testing was conducted in Chapters 4, 6 and 8. In Chapter 7, differences highlighted in the text have been statistically tested at the 95% significance level. The term 'significant' refers to statistical significance and is not intended to imply substantive importance.

Executive summary

Introduction

The Diet and Nutrition Survey of Infants and Young Children (DNSIYC) was commissioned by the Department of Health (DH) and the Food Standards Agency (FSA) to provide detailed information on the food consumption, nutrient intakes and nutritional status of infants and young children aged 4 up to 18 months[1] living in private households in the UK. The survey was carried out by a consortium of organisations: Medical Research Council Human Nutrition Research (MRC HNR), NatCen Social Research (NatCen), the MRC Epidemiology Unit and the Human Nutrition Research Centre at Newcastle University. The fieldwork in Northern Ireland (NI) was carried out by the Northern Ireland Statistics and Research Agency (NISRA). Fieldwork was carried out between January and August 2011.

DNSIYC provides the only source of high quality nationally representative data on the types and quantities of foods consumed by the 4 to 18 month age group, from which estimates of nutrient intakes are derived. This information will be used alongside data from the National Diet and Nutrition Survey (NDNS)[2], which covers adults and children of all ages from 18 months, to provide a fuller picture of the diet, health and food safety of the nation, in supporting public health policy and food safety assessments. The survey was carried out in all four countries of the UK and was designed to be representative of the UK population. Additional recruitment was undertaken in Scotland and among those in receipt of Healthy Start (HS)[3] vouchers in order to provide more detailed analysis of these populations. These additional samples are referred to as 'boosts'. Results for the boosted Scottish sample form a separate report published on the Scottish Government website, and results for the boosted HS sample are presented in Annexe A of this report.

Methods

The survey had two stages:

Stage 1: Carried out in the participant's home:

- Detailed face-to-face interview to collect background information on family dietary habits, socio-demographic status and health information, feeding practices, eating patterns, developmental stages, sunlight exposure and gastrointestinal symptoms.
- Dietary data collection (food diary, completed for four consecutive days) to provide a quantitative estimate of food consumption and nutrient intakes.
- Physical measurements (height and weight of mother; length, weight and head circumference of child).

Stage 2: Carried out in a clinic or mobile unit:

- Stable isotope assessment to estimate fluid intake, breast milk intake and body composition.
- Skinfold thickness to measure body composition.
- Blood sample collection for the analyses of iron and vitamin D status.

Response rates and sample

A total of 4,451 individuals were sampled from Child Benefit (CB) Records, of which 97% were eligible to take part. Of those eligible, 62% completed three or four dietary recording days[4]. This gave a sample size of 2,683 fully productive individuals. Forty four per cent (i.e. 973) of eligible fully productive individuals (2,228 excluding Scottish boost) attended a clinic. At the clinic, 98% provided a skinfold thickness measurement, 87% completed the stable isotope component and 55% provided a blood sample. Weighting factors were applied to ensure that the results were representative of the UK population.

The profile of the achieved sample was close to that of the population of infants and young children achieved from CB records in the UK in terms of age, sex, ethnicity and region. After applying weighting factors, 82% of children in DNSIYC were white, 8% were Asian, 3% were black, and 7% were mixed or other. There was a wide range of socioeconomic circumstances for the children in the survey, and they were evenly distributed between housing that was owned and rented. A fifth (21%) received Healthy Start (HS) vouchers, which is in line with estimated uptake for children of this age in the general UK population.

Contents of this report

The results in this report cover the following areas:

- Sample characteristics including use of child care, smoking and drinking habits of family members, neurological development, medical history, sun exposure and maternal characteristics
- Physical measurements
- Feeding practices
- An estimation of breast milk consumption
- Food consumption
- Use of dietary supplements
- Energy, macronutrients and micronutrient intake
- Iron and vitamin D status

Recommendations for infant feeding, diet and nutrition

The Department of Health recommends that:

- Mothers exclusively breastfeed for around the first six months of the child's life [5,6].
- For those who choose to use breast milk substitutes, follow-on formula and 'goodnight' milks should not be introduced before the child is six months of age [7,8].
- At around six months of age a variety of complementary foods[9] should be introduced alongside continued breastfeeding (and/or breast milk substitutes, if used)[5].
- Cow's milk should not be introduced as a main drink until after 12 months[8]. If provided, this should be whole (not semi-skimmed) milk until at least two years of age.
- Salt should not be added to children's food[8].
- Vitamin A, C and D supplements should be given from six months unless the child is formula fed and receiving more than 500ml of formula per day. Breastfed infants born to mothers with a low vitamin status may require supplements earlier, from the age of one month[8].
- Breastfeeding mothers should take vitamin D supplements of 10µg per day[10].
- If formula feeding, guidance regarding the safe preparation, storage and handling of infant formula should be followed, for example: Powdered formula should be made up as needed, with boiled water that has been allowed to cool for no more than 30 minutes[11].
- For optimum dental health mothers should start to introduce infants to drinking from cups and beakers from about six months[8] and tooth brushing twice a day should begin as soon as teeth begin to appear[12].

Reporting of results

Adequacy of nutrient intake for the population is assessed by comparing intake with age/sex specific UK Dietary Reference values (DRVs)[6]. The only DRVs set for this age group for macronutrients are an Estimated Average Requirement (EAR) for energy[13] and a Reference Nutrient Intake (RNI) for protein. For vitamins and minerals, mean intakes as a proportion of the RNI and the proportion with intakes below the Lower Reference Nutrient Intake (LRNI) are given. The RNIs and LRNIs for each vitamin and mineral are shown in tables 6.19 and 6.28.

Blood analyte measures for iron and vitamin D are compared with threshold values. These generally indicate the proportion of people at greater risk of deficiency of a nutrient due to depleted stores or tissue concentrations.

Results for the dietary data are presented for four age groups: 4 to 6 months, 7 to 9 months, 10 to 11 months and 12 to 18 months. Results for the data collected at the clinic, including blood status data and stable isotope estimates of breast milk consumption, are presented for two age groups: aged 5 to 11 months and aged 12 months or over. This is due to the small sample sizes and the ageing of the child between the home and clinic visits.

Methodological issues

Mis-reporting of food consumption is known to be a problem in all dietary surveys, although it is not known to what extent it is a problem for infants and young children aged 4 to 18 months. In this age group there may be a particular risk of under or overestimating food wastage. The potential for some mis-reporting needs to be borne in mind when interpreting findings from this survey.

The results based on assessment of food consumption over four days indicate dietary intake over a short period, so infrequently consumed foods may be under or overestimated. Analysis of blood samples provides an indication of the nutritional status of the population usually over a longer period. Nutritional status means the concentration of nutrients available to the body (after absorption) for use in metabolic processes and in this age group includes any stores acquired in utero. In DNSIYC, dietary intake therefore cannot be compared directly to nutritional status, as status does not just reflect the intake of nutrients from the diet.

Key Findings

Overall findings

Infants and young children aged 4 to 18 months in DNSIYC were reported to consume a varied diet; dietary recommendations were generally met by the majority of the population. The proportion of children in DNSIYC who had ever been breastfed (78%), the duration of breastfeeding (57% were not breastfed beyond 3 months), and the frequency of feeding through the day for those being breastfed at the time of the survey (ranging from one to nine or more times a day depending on age) were similar to the Infant Feeding Survey (IFS) of 2010[14]. Twenty nine per cent of children aged 4 to 6 months consumed breast milk during the four-day food diary period, decreasing to 8% of those aged 12 to 18 months. Two children (aged 4 to 6 months) were exclusively breastfed at the time of the survey. Infant formula was the largest contributor to energy intake for children aged under 12 months (31% to 51%) while the food category 'milk and milk products' was the largest contributor for those aged 12 to 18 months.

A progression in ability to eat pureed and lumpy foods, finger foods, drink from a cup or beaker with a spout, and use a spoon was reported with age. Most of the children who had food other than milk 'almost always' (28%) or 'sometimes' (31%) had the same food as their parents, or 'sometimes' had a different meal to, but prepared by, their parents (41%). Twenty four per cent never had the same food as their parents, although this was more common for younger children. Over half (58%) of children who had food other than milk had eaten a commercial baby or toddler meal and a fifth had eaten a commercially prepared adult ready meal. Baby rice was the most common first food for children in DNSIYC (65%), followed by pureed fruit or vegetables (21%).

The mean total fruit and vegetable consumption, including contribution from mixed dishes, was relatively high (similar to consumption in teenagers[2]) ranging from 100g per day for children aged 4 to 6 months to 170g per day for those aged 12 to 18 months, equivalent to one to two 80g adult portions per day. Consumption was significantly lower in the routine and manual socio-economic category compared to the managerial and professional category and significantly lower in South Asian and children of 'other' ethnicity compared to white children aged 4 to 18 months.

Mean intakes of breast milk estimated from stable isotope methods were 470g, 350g, 400g for children aged 6 to 9 months, 10 to 11 months and 12 months and over respectively.

In general, children in DNSIYC were taller (i.e. longer), heavier and had larger head circumferences and subscapular skinfold thickness than the UK-WHO Growth Standard for their age and sex. This might be partially explained by the predominance of formula feeding in this group at the time of the survey, as predominantly formula fed children are on average larger for their age compared to exclusively or predominantly breastfed children on which these growth standards are based.

Food consumption patterns were in general similar in the DNSIYC HS sample as for the DNSIYC UK sample. There did not appear to be any consistent variations in the diet by socio-economic category or ethnicity, other than specific differences mentioned here.

Findings relevant to recommendations

- Twenty two per cent had never been breastfed, of those who were breastfed, 57% were not breastfed beyond three months of age.
- Thirty two per cent of infants aged 4 to 6 months consumed follow-on formula, which is not recommended before six months.
- Complementary foods were introduced before the age of three months for 10% of children, and before five months for 75% of children. For 22% of children, foods were introduced at six months and 3% at seven months or more.

- Children aged below one year generally consumed no more than a quarter of a pint (146g) of whole milk per day, in keeping with the recommendation. For example, 15% aged 4 to 6 months consumed whole cow's milk over the survey period with a mean consumption of 53g per day among consumers. This increased to 79% of those aged 12 to 18 months with a mean consumption of 329g per day.
- A small proportion of children consumed semi-skimmed milk, 5% of infants aged 4 to 6 months with mean intakes of 40g per day among consumers increasing to 13% of children aged 12 to 18 months with mean intakes of 169g per day among consumers. Small proportions of children consumed other milk including 1% milk, skimmed milk and cream, increasing from 1% of those aged 4 to 6 months to 10% of those aged 12 to 18 months.
- For those children who had food other than milk, most parents (83%) reported 'never' adding salt to the child's food.
- Over the four-day food diary period, the proportion of children given a micronutrient supplement ranged from 5% for those aged 4 to 6 months to 10% for those aged 12 to 18 months, most often a multi-vitamin supplement. Children aged 4 to 18 months of South Asian and 'other' ethnicities were more likely to be given at least one supplement during the four-day food diary period than white children.
- Nearly half (46%) of breastfeeding mothers took supplements, most often a multi-vitamin and mineral supplement, which were taken by 27% of all breastfeeding mothers. The proportion taking supplements containing 10µg vitamin D is not known.
- The majority of parents feeding their child infant formula in the home followed recommendations for preparation. For example, 79% reported making up the formula as needed and 68% used water that had been left to cool for no longer than 30 minutes.
- The proportion of children who had ever drunk from a cup or beaker with a spout increased with age, from 47% of those aged 4 to 6 months, rising steadily to 95% of those aged 12 to 18 months.
- A toothbrush was reported to be used at least once every day for 66% of children with at least one tooth.

DRVs and blood analyte threshold values

- Seventy five per cent of boys and 76% of girls exceeded the EAR for energy.
- Mean protein intakes were well above the RNI in all age groups.
- Mean daily intakes of key vitamins and minerals from all sources (including supplements) were above or close to the RNI for all age groups with the exception of vitamin D for non-breastfed children aged 12 to 18 months and for

breastfed children (by any degree of breastfeeding), across all age groups, although these are underestimates as they do not include the contribution of breast milk to vitamin D intake.

- The proportion of children with daily intakes of vitamins and minerals from all sources below the LRNI was low (8% or less) except for iron for all age groups (10% to 14%) and magnesium for infants aged 4 to 6 months (10%).
- For those aged 12 to 18 months, the proportion with intakes of iron below the LRNI was significantly greater for South Asian (28%) and 'other' (19%) children compared to white children (11%), as well as for children in the routine and manual category (17%) compared to the managerial and professional category (8%).
- Mean daily intakes of sodium were only 85% of the RNI for children aged 4 to 6 months, but increased to 181% for children aged 12 to 18 months. This equates to an intake of 2.3g salt per day for children aged 12 to 18 months, exceeding the population recommendation for this age group of no more than 2g salt per day.
- The majority of children had adequate haemoglobin and serum ferritin concentrations, with only about 3% below the thresholds at which anaemia is indicated.
- Ninety four per cent of children aged 5 to 11 months and 98% of children 12 months or over, had 25-hydroxyvitamin D (25-OHD) concentrations above the lower threshold for vitamin D adequacy.

References and endnotes

[1] Includes children aged up to 17 months and 28-31 days.

[2] The National Diet and Nutrition Survey (NDNS) is a UK survey of the food consumption, nutrient intakes and nutritional status of people aged 1.5 years and older living in private households. The NDNS is currently structured as a 'rolling programme' of continuous fieldwork. Headline results are published annually:
http://transparency.dh.gov.uk/2012/07/25/ndns-3-years-report/

[3] Healthy Start is a Government scheme set up to offer a nutritional safety net for pregnant women, new mothers and children under 4 years of age in very low income families, and encourage them to eat a healthier diet. The scheme provides vouchers to put towards the cost of milk, fruit and vegetables or infant formula, and coupons for free Healthy Start vitamin supplements (see Annexe A for more details).

[4] Respondents completing three or four diary days were considered fully productive.

[5] World Health Organization. The optimal duration of exclusive breastfeeding: Report on an expert consultation. Geneva (2001)

[6] Department of Health, Infant Feeding Recommendation, 2003. Available online:
http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4096999.pdf

[7] Department of Health. 1994. Weaning and the weaning diet. Report on health and social subjects, 45. HMSO, London.

[8] Scientific Advisory Committee on Nutrition. 2008. Consideration of the Place of 'Goodnight Milk' products in the diet of infants aged 6 months and above. Available online:
http://www.sacn.gov.uk/pdfs/final_sacn_statement_on_good_night_milks.pdf

[9] Complementary foods/feeding: the period where infants make the gradual transition from liquid foods to eating solid and family foods.

[10] Report of Health and Social Subjects 41 *Dietary Reference Values (DRV's) for Food Energy and Nutrients for the UK.* Report on the Panel on DRV's of the Committee on Medical Aspects of Food Policy (COMA) 1991. The Stationery Office. London.

[11] The key recommendations for making and storing powdered infant formula are:

- Feeds should be made up with boiled water that has been allowed to cool to no less than 70°C. Thus the feed should be made within 30 minutes after the water has boiled.
- When making the feed the boiled water should be added to the bottle first, followed by the correct amount of powdered formula.
- Once the feed is prepared it should be cooled as quickly as possible to feeding temperature.
- Ideally, powdered formula should be made up fresh for each feed rather than being stored. Although not ideal, feeds can be made up and stored below 5°C for a maximum of 24 hours.
- If mothers need to feed their infant when away from home they should make up fresh feeds as they need them, following the recommendations above.
- It is suggested that mothers may consider carrying a flask of just boiled water with them when away from the home. Alternatively, mothers could use a liquid ready-to-feed formula when away from home

NHS Guide to Bottle Feeding 2011. Available online: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_124526.pdf

[12] Department of Health, Delivering Better Oral Health (2nd edition 2009). Available online: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_102982.pdf

[13] Scientific Advisory Committee on Nutrition. *Dietary Recommendations for Energy*. The Stationery Office (London, 2011).

[14] The Infant Feeding Survey (IFS) is a longitudinal postal survey carried out every five years, which collects information on infant feeding practices across the UK for infants aged 4 weeks to 10 months. Available online: http://www.ic.nhs.uk/searchcatalogue?productid=9569&q=infant+feeding+survey&sort=Relevance&size=10&page=1#top

Chapter 1 Background and purpose

1.1. Introduction

The Department of Health (DH) and the Food Standards Agency (FSA) commissioned this survey to provide detailed information on the food consumption, nutrient intakes and nutritional status of infants and young children. This information is needed to provide a robust evidence base for their work to develop and implement sound public health policies and to protect consumer safety.

Breast milk is the ideal form of nutrition for infants and exclusive breastfeeding[1] is recommended for around the first six months (26 weeks) of an infant's life[2,3]. For breastfed, breast milk substitute fed and mixed fed infants DH recommends that complementary foods[4] should be introduced at about six months of age, and that breastfeeding (and/or breast milk substitutes, if used) continues beyond this time, alongside appropriate types and amounts of complementary foods. Complementary feeding should be adequate, meaning that the complementary foods should be given in the quantities and at a frequency and consistency that will meet the nutritional needs of the growing child while maintaining breastfeeding and/or feeding breast milk substitutes[5]. A variety of foods should be used. The current feeding policy for infants and young children is designed to optimise nutrition at a specific stage of growth and development. Therefore, food and nutrient intakes should not be compared to nutrient guidelines set for older children or adults.

DH and the FSA obtain information on the dietary habits and nutritional status of the United Kingdom (UK) population through dietary surveys, such as the National Diet and Nutrition Survey (NDNS)[6]. However, the current NDNS rolling programme, and earlier surveys including the survey of children aged 1½ to 4½ years (1995)[7], do not collect information on those under 18 months of age. The last national survey of infants, an investigation of food and nutrient intakes of British infants aged 6 to 12 months[8], was commissioned by the Ministry of Agriculture, Fisheries and Food (MAFF) and carried out in 1986/87. Since 1975, information about feeding practices of infants and young children up to the age of 10 months has been derived from the Infant Feeding Survey (IFS)[9], which is currently carried out every five years funded by UK Health Departments. However, the IFS does not collect information on actual quantities of foods consumed. Government advice on breastfeeding, complementary feeding and dietary habits has changed[10] since the last dietary survey of this age group was carried out in the 1980's, indicating a call for more current information. There was therefore a need to address the gap in the evidence base for this age group.

Following a tendering process, DH and FSA commissioned a consortium comprising Medical Research Council Human Nutrition Research (MRC HNR) based in Cambridge, NatCen Social Research[11] (NatCen) based in London, the MRC Epidemiology Unit based in Cambridge and the Human Nutrition Research Centre at Newcastle University

to carry out the Diet and Nutrition Survey of Infants and Young Children (DNSIYC), a survey of infants and young children aged four months up to 18 months in the UK. The fieldwork in Northern Ireland (NI) was carried out by the Northern Ireland Statistics and Research Agency (NISRA).

DNSIYC provides detailed information on the diet and nutrition of individuals aged four months up to 18 months[12] from private households. The data from DNSIYC will be used alongside data from NDNS to provide a fuller picture of the diet and health of the nation, than is possible from data previously available, starting from the age at which complementary feeding typically begins. This will support public health policy and food safety assessments. The survey was carried out in all four countries of the UK and was designed to be representative of the UK population. Additional recruitment was undertaken in Scotland and among those in receipt of Healthy Start (HS) vouchers[13] in order to provide more detailed analysis of these populations. These additional samples are referred to as 'boosts'. The Scottish survey forms a separate report published on the Scottish Government website and the HS survey forms Annexe A of this report.

DNSIYC involved two stages; Stage 1 consisted of a series of home visits to collect background information and carry out the dietary assessment components of the survey, as well as physical measurements of the child (length, weight and head circumference) and mother (height and weight); Stage 2 was a clinic visit consisting of additional physical measurements of the child including skinfold thickness measurements and measurement of body composition of the child and estimation of breast milk and fluid intake using stable isotopes. A blood sample was also taken from the child for assessment of iron and vitamin D status.

This report presents findings from the survey, fieldwork for which was carried out between 6 January 2011 and 30 August 2011. Pilot work to test methods of the survey is reported in Annexes B and C.

1.2. Aims

The survey fieldname was 'The National Infant Diet and Health Study'. The fieldname was used for interactions with parents of participants, including participant information sheets and associated documentation.

The specific aims of DNSIYC were to:

- Provide detailed, quantitative information on the food and nutrient intakes, sources of nutrients, and nutritional status of a representative sample of infants and young children aged 4 to 18 months from the UK population, as a basis for developing government policy and measuring progress towards other government objectives.

- Provide detailed, quantitative information on breast milk and breast milk substitutes consumed by the population group under study.
- Describe the characteristics of participants with intakes and/or status of specific nutrients that are above and below national reference values, and evaluate the diet of this population compared to current national recommendations.
- Produce a database of food consumption to provide the basis for the calculation of likely dietary intakes of natural toxicants, contaminants, additives and other food chemicals for risk assessment.
- Provide length (height), weight and other body measurements and examine their relationship with dietary intake and status, and health and social factors.
- Examine the extent to which feeding practices adopted by carers of this population group differ from national policy for infant health.
- Provide some information on the dietary habits of the mother (and other key family members) and link this to the nutrient intakes and nutritional status of this population group.
- Carry out stable isotopically-labelled water assessment in sub-samples of the survey group in order to estimate breast milk intake and body composition in children consuming any breast milk, as well as fluid intake and body composition in non-breastfed children.
- Measure blood indices that give evidence of nutritional status and relate these to dietary, physiological and social data.

National recommendations for nutrient intakes are listed in relevant chapters.

1.3. Sample boosts

In Scotland the sample comprised additional locations to boost the total number of participants to around 500. This has enabled dietary results to be reported separately for Scotland. The Scottish results are presented in the report entitled "Diet and Nutrition Survey of Infants and Young Children in Scotland, 2011", published on the Scottish Government website. The Scottish survey was a dietary survey only and did not report results for the clinic stage of the survey as Scottish boost participants were not invited to attend a clinic visit (see section 2.5).

The number of HS recipients was increased in a boost sample for the survey. The aim was to boost the sample to 400 participants. This boost sample was combined with HS recipients in the core sample to form the HS sample. The boosted data were also included in the UK sample, although these were down weighted so the UK sample was representative of the UK population.

1.4. Structure of the report

The following chapters detail the methods and results for the UK sample, including the boosts:

- Chapter 1: Background and purpose of DNSIYC
- Chapter 2: Preliminary studies, research designs and methodology
- Chapter 3: Sample characteristics and survey response rates
- Chapter 4: Physical measurements
- Chapter 5: Feeding practices
- Chapter 6: Food consumption and nutrient intakes
- Chapter 7: Comparisons
- Chapter 8: Blood analyses

Results for the HS sample are presented in a separate annexe (Annexe A) and results for the Scottish survey are published as a separate report.

References and endnotes

[1] Exclusive breastfeeding: the infant only receives breast milk without any additional food or drink, not even water.

[2] World Health Organization. The optimal duration of exclusive breastfeeding: Report on an expert consultation. Geneva (2001)

[3] Department of Health, Infant Feeding Recommendation, 2003 Available online at: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4096999.pdf

[4] Complementary foods/feeding: the period where infants make the gradual transition from liquid foods to eating solid and family foods.

[5] http://www.who.int/nutrition/topics/complementary_feeding/en/index.html

[6] The National Diet and Nutrition Survey (NDNS) is a UK survey of the food consumption, nutrient intakes and nutritional status of people aged 1.5 years and older living in private households. The NDNS is currently structured as a 'rolling programme' of continuous fieldwork. Headline results are published annually: http://transparency.dh.gov.uk/2012/07/25/ndns-3-years-report/

[7] Gregory J, Collins DL, Davies PSW, Hughes and Clarke PC. National Diet and Nutrition Survey: Children aged 1½ to 4½ years. Volume 1: Report of the diet and nutrition survey. HMSO (London: 1995)

[8] Mills A. and Tyler H. Food and Nutrient intakes of British infants Aged 6-12 months 1992. The Stationery Office

[9] The Infant Feeding Survey (IFS) is a longitudinal postal survey carried out every five years, which collects information on infant feeding practices across the UK for infants aged 4 weeks to 10 months. Available online: http://www.ic.nhs.uk/statistics-and-data-collections/health-and-lifestyles-related-surveys/infant-feeding-survey/infant-feeding-survey-2010

[10] Prior to 2003 the recommendation was for mothers to exclusively breastfeed for 4 months, however in 2003 this was changed to 6 months, see reference 3.

[11] Previously called the National Centre for Social Research (NatCen).

[12] Includes children aged up to 17 months and 28-31 days.

[13] Healthy Start is a Government scheme set up to offer a nutritional safety net for pregnant women, new mothers and children under 4 years of age in very low income families, and encourage them to eat a healthier diet. The scheme provides vouchers to put towards the cost of milk, fruit and vegetables or infant formula, and coupons for free Healthy Start vitamin supplements (see Annexe A).

Chapter 2 Methodology

2.1. Preliminary/development work

A series of pilot studies were undertaken to determine the best way to measure what infants and young children eat and drink in a national survey such as the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) and to assess the use of utensils in the estimation of portion sizes in this age group. This pilot work was undertaken by the Human Nutrition Research Centre at Newcastle University. In addition a Dress Rehearsal of the entire protocol was conducted by the survey consortium to ensure all components of the survey were effective and viable. These preliminary studies covered:

- A consultation designed to ascertain from mothers their views on the most convenient and feasible way of measuring children's food consumption.
- Two pilot studies to test food diaries and equipment.
- A Dress Rehearsal to test the overall response to the survey and all components included in the protocol.

See Annexe B for details of the consultation and pilots and Annexe C for details of the Dress Rehearsal.

The following recommendations were made at the end of the pilot work:

- The mean food intake (g) and mean energy intake (kcal) recorded by the estimated intake method[1], supported by the use of measuring tubs and spoons, were statistically different to those of weighed intakes. The estimated intake method slightly underestimated the amount of food (on average 17g) and slightly overestimated energy intake (on average 32kcal). All estimates of food intake and 92% of estimates of energy intake lay within 50% of the weighed intake. The estimated intake method was, therefore, considered a feasible and viable method for use in the main survey.
- Parents had a preference for recording the amount of food served and left over, rather than calculating themselves the amount consumed so this was incorporated into the diary for the main survey.

Both these recommendations were adopted during the Dress Rehearsal. The recommendations made at the end of the Dress Rehearsal were numerous and are outlined in section 9 of Annexe C. These were all adopted during the mainstage survey. Two significant outcomes were:

- It was decided not to use measuring equipment to assess quantities of foods consumed as it involved an avoidable step of converting volumes to weights. Household measures were used instead.
- Head circumference and infant length as well as weight were measured by interviewers at Stage 1.

2.2. Ethical approval

Following reviews by MRC HNR's internal Research Governance Committee, an application for external ethical approval for the survey was submitted on 4 November 2009, for review by the Cambridgeshire 4 Research Ethics Committee (REC) at their meeting on 26 November 2009. A favourable provisional opinion was given on 4 December 2009, subject to further information requested from the consortium and some administrative issues. Full ethical approval for the survey was received from the Cambridgeshire 4 REC on 18 January 2010.

Further information about the ethical process can be found in the Methodology appendix (see Appendix A).

2.3. Sample design

A sample of infants and young children representative of the UK population aged 4 to 18 months was drawn using a multi-stage random probability design. Individuals were randomly selected from Child Benefit (CB) records provided by Her Majesty's Revenue and Customs (HMRC)[2]; the Healthy Start (HS) [3] sample was drawn from the HS recipient database provided by DH. The CB and HS samples were stratified by Government Office Region, Index of Multiple Deprivation scores and population density to ensure representativeness (see Appendix A for details). At the time of the survey, CB was a universal credit with a high rate of take up (around 98%) making it a good sampling frame for a survey such as this. However, it does have limitations and these are discussed in the Methodology appendix (see Appendix A).

The sample comprised three parts:

1) A core sample of children selected at random from CB records and covering all four countries of the UK.
2) A boost sample of children on the HS scheme selected at random from DH's HS database. This boost sample was combined with children on the HS scheme in the core sample to form the HS sample.
3) A boost sample of children in Scotland, also drawn from CB records completing Stage 1 only. This boost sample was combined with Scottish participants in the core sample to form the Diet and Nutrition Survey of Infants and Young Children in Scotland[4].

Weighting factors were applied to ensure that the results were representative of the UK population (see section 2.3.5). Refer to Appendix A for more details about the sample selection process.

2.3.1. Age

The sample drawn from the CB Register was selected in two waves. This was done to try to ensure that the sample contained sufficient numbers of children at each end of the eligible age range, i.e. from 4 to 18 months. Interviews with the parents of participants aged 17 months were prioritised to reduce the number of children who would become ineligible through being beyond the specified age range at the time of interview. Similarly, interviews with the parents of participants aged four months were prioritised to maximise participation of children of this age.

The age of the child was recorded during the home interview at Stage 1 and again at the clinic at Stage 2, if a visit took place. Every effort was made to ensure that the clinic visit took place as soon after the home interview as possible to minimise the period between the home and clinic visits and to maximise the number of children still being breastfed by the time of the clinic visit. However, some children who were being breastfed at the interview stage were no longer breastfeeding at the clinic stage. More information on the age of children at interview and at clinic visit is presented in Appendix A and Chapter 3 of this report.

2.3.2. Inclusion/exclusion criteria

As stated in the introduction, exclusive breastfeeding is recommended for around the first six months of an infant's life. However, complementary feeding often commences earlier than six months. Therefore, the sample included infants and children from four months to capture those who were receiving complementary foods earlier than six months. The full age range of the survey included children aged 4 to 18 months. Those who had turned 18 months by the time of the first interview were screened out.

Children with a birth weight under 2kg and/or those fed through a gastric tube at or after one week of age were excluded at the main interview stage. The latter criterion was chosen to exclude those individuals with congenital abnormalities likely to affect feeding practices[5].

Participants who no longer lived at the selected address when the sample was drawn were still considered eligible to participate if they had moved locally and a new address could be obtained. The parent of the participant who had the most involvement in the feeding of the child was selected as the interviewee. Only parents or legal guardians could be selected to complete the interview and to provide consent.

All children for whom at least three days of the food diary had been completed (i.e. fully productive participants) were regarded as eligible for a clinic visit.

2.3.3. Selecting postcode sectors

Postcode sectors were selected by NatCen using CB claimant records provided by HMRC and information about HS recipients from DH. See Appendix A for more information on methodology, including selecting postcode sectors and participants.

2.3.4. Seasonality

Ideally, it would have been desirable to assess seasonal variation in diet across the sample, however, it was not possible for fieldwork to span an entire year due to limited access to CB records. Consequently, it was not possible to detect seasonal variation in diet in DNSIYC and it is not reported.

2.3.5. Weighting the survey data

DNSIYC required a set of weighting factors to adjust the sample for differences in sample selection and response. The weighting factors adjust for differential selection probabilities of boost sample members, non-response to the interviewer stage, non-response to the clinic visit and non-response to providing a blood sample.

An interview weighting factor was required for participants who responded to the individual interview and completed three or four food diary days. This weighting factor was generated using a combination of logistic regression modelling and calibration. The aim was to reduce bias resulting from sampling error and differential non-response.

Further information about weighting the sample can be found in Appendix B.

2.4. Overview of methodology

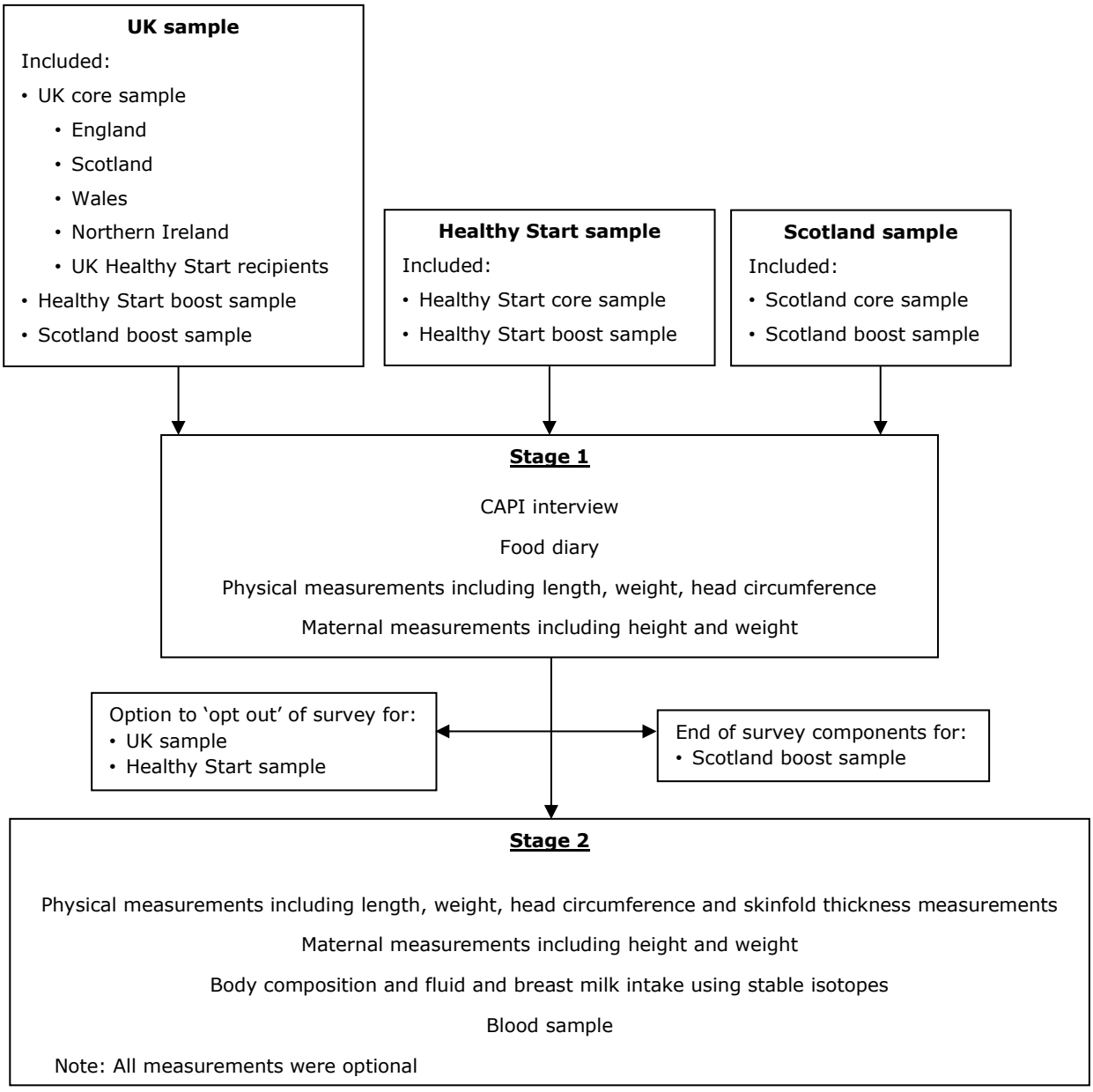
This section provides an overview of the methodology employed in the mainstage fieldwork of DNSIYC. The survey aimed to collect data from a representative sample of 2,246 infants and young children aged 4 to 18 months living in private households across the UK, including boosts. This sample size was chosen to enable robust analyses on different age groups and boosted samples. The key components were:

- Face-to-face interviews, conducted using Computer Assisted Personal Interviewing (CAPI) with the parent most involved in feeding the sampled child.
- Dietary data collection, using a four-day estimated food diary.
- Anthropometric measurements (maternal height and weight; infant length, weight and head circumference; and skinfold thickness).

- Measures of body composition, fluid and breast milk intake.
- Collection of blood samples.

Copies of all survey documents are included in Appendices C to I. Figure 2.A sets out the movement of participants through the survey.

Figure 2.A. Summary of stages included in DNSIYC



Two weeks in advance of starting fieldwork, a letter describing the purpose of the survey was sent to each sampled child's parent or legal guardian (referred to as 'the parent'). This letter provided the parent of the sampled child with the opportunity to 'opt-out' of the survey prior to the beginning of fieldwork.

Parents of participants who took part in the CAPI interview and completed a food diary for at least three days were classified as 'fully productive' and were invited to attend a local clinic where, with consent, additional child and maternal anthropometric measurements and child blood samples were taken. In addition, participants were invited to take a stable isotope dose in order to measure body composition, fluid intake and breast milk intake (if breastfed) and participate in a urine collection protocol over five or 14 days, depending on whether or not the child was being breastfed (refer to Appendices A and J for more details).

2.5. Overview of survey components and fieldwork procedures

Fieldwork assignments were issued to interviewers in two waves each consisting of two stages. The first stage was an interviewer visit to the participant's home. Having successfully completed Stage 1, parents who were interested consented to details of participants being transferred from the interviewer to MRC HNR to arrange a clinic appointment. Stage 2 involved the participant visiting a clinic, followed up by a brief home visit by the interviewer.

Wave 1
Stage 1 - Interviewers: 6 January – 1 March 2011
Stage 2 - Clinics: 17 January – 25 May 2011
Stage 2 - Interviewers: 22 January – 1 June 2011

Wave 2
Stage 1 - Interviewers: 28 March – 23 May 2011
Stage 2 - Clinics: 11 April – 18 August 2011
Stage 2 - Interviewers: 15 April – 30 August 2011

The two main stages of data collection comprised the following:

Stage 1: Interview visit

- Detailed face-to-face interview using CAPI to collect background information on family dietary habits, socio-demographic status and health information, as well as information about the child such as feeding practices, eating patterns, developmental stages, sunlight exposure and gastrointestinal symptoms (see Appendix C).
- Dietary data collection (estimated food diary, completed for four consecutive days) to provide a quantitative estimate of food consumption and nutrient intakes (see Appendices D and E).
- Physical measurements (height and weight of mother; length, weight and head circumference of child) in order to assess growth (see Appendix A).

Stage 2: Clinic visit

- Stable isotope assessment to estimate fluid intake, breast milk intake and body composition (see Appendices A and J).
- Skinfold thickness to measure body composition (see Appendix A).
- Blood sample collection for the analyses of iron and vitamin D status (see Appendix A).
- Follow-up interviewer visit to the home to collect urine samples required for the stable isotope assessment (see Appendix A).

Details of documents used by interviewers and clinical staff are provided in Appendices F to I. The full methods, and benefits and limitations of various methods, are discussed in Appendix A.

2.6. Comparison of dietary to blood data

The blood sampling was intended to provide an assessment of nutrient status for two key nutrients (iron and vitamin D). The dietary data are based on assessment of food consumption over four days and indicate dietary intake over a short period, so infrequently consumed foods may be under or overestimated. Analysis of blood samples provides an indication of the nutritional status of the population usually over a long period. Nutritional status means the level of nutrients available to the body (after absorption) for use in metabolic processes and in this age group includes stores acquired in utero. It was therefore not possible to link the intake and status data in individuals or groups in DNSIYC as status does not just reflect the intake of nutrients from the diet.

2.7. Feedback to participants and General Practitioners

Various types of feedback were provided to participants' parents and General Practitioners (GPs), with parental agreement. These are described in Appendix A and examples can be found in Appendix K.

2.8. Fieldwork quality control

Quality control measures for fieldwork were put in place to monitor the quality of completion of the food diaries and also to monitor interviewer and nurse measurements. Refer to Appendices A and L for further details.

2.9. Tokens of appreciation

At the final interviewer visit, the interviewer gave a token of appreciation (£30 in high street vouchers) to all who had completed at least three food diary recording days.

Tokens of appreciation were also given for each component of the clinic visit. Each participant's parent was given £10 in high street vouchers for taking part in Stage 2. A further £30 voucher was given for taking part in the stable isotope measurement or £50 for the more intensive breast milk intake protocol. An additional £30 voucher was given to all who took part in the blood sample component, where a sample was attempted, regardless of whether it was obtained. A toy was also used to distract the child to increase compliance for the components, and was given to the child to take home.

References and end notes

[1] Estimated intakes were recorded as served and left over.

[2] HMRC supplied a sample of names, addresses of CB claimants under Paragraph 9, Schedule 5, Tax Credits Act 2002 which gives authority to supply information to other Departments for the purposes of provision of information for health purposes. CB records were used as a sampling frame and selected sample supplied to DH for the purpose of DNSIYC. The sample transfer between HMRC and DH was in line with Government security standards and with the agreement of the HMRC Data Guardian from the business area from which data is sourced. Data transfer was in adherence to the strict data transfer rules, and with the correct legal gateways in place.

[3] Details on the Healthy Start boost sample can be found in Annexe A.

[4] Details of the Diet and Nutrition Survey of Infants and Young Children in Scotland, 2011 can be found in a separate report on the Scottish Government website. Available online: http://www.scotland.gov.uk/Publications/Recent

[5] A congenital abnormality that affects feeding is defined as a physical defect that was present at birth which is likely to impair feeding or growth.

Chapter 3 Sample characteristics

Summary of sample

- The Diet and Nutrition Survey of Infants and Young Children (DNSIYC) achieved a total sample of 2,683 fully productive infants and young children aged between 4 and 18 months.

- The profile of the achieved sample was very close to that of the population of infants and young children in the UK in terms of age, sex, ethnicity and region. After applying weighting factors, 82% of children in DNSIYC were white, 8% were Asian, 3% were black, and 7% were mixed or other.

- There was a wide range of socioeconomic circumstances for the children in the survey, and they were evenly distributed between housing that was owned and rented. A fifth (21%) received Healthy Start (HS) vouchers, in line with estimated uptake for children of this age in the general UK population.

- Most mothers stopped smoking once they found out they were pregnant, but among the 17% who continued, there was a higher proportion of younger mothers (38% of this age group continued to smoke once they knew they were pregnant). On the other hand, older mothers (71% of mothers aged 35 years or over) were significantly more likely to drink alcohol and to have continued to drink when they knew they were pregnant compared to younger mothers. Overall, 25% of mothers continued to drink alcohol when they knew they were pregnant.

- For a large proportion of children in the survey (44%), the parents were the only carers for the child; for those who did have other care, grandparents were the most frequent carers (34%), much more so than nurseries (14%), other relatives (9%) or childminders or nannies (7%).

- Overall the diets of older mothers were generally healthier than younger mothers, in that mothers aged 35 years or over were significantly more likely to eat breakfast and fruit and vegetables more often, were significantly more likely to consume semi-skimmed or skimmed milk, and to eat crisps less often than younger mothers. They were also significantly more likely to eat wholemeal and brown bread rather than white, to eat oily fish more often and to use olive oil for cooking than younger mothers. However, they ate cakes significantly more frequently than younger mothers.

- Nearly half (46%) of breastfeeding mothers took supplements, most often a multi-vitamin and mineral supplement, taken by 27%.

3.1. Representativeness of the sample

3.1.1. Achieved UK sample compared to entire Child Benefit extract

The Diet and Nutrition Survey of Infants and Young Children (DNSIYC) achieved a total sample of 2,683 fully productive children aged between 4 and 18 months. Table 3.1.1 shows population characteristics of Child Benefit (CB) recipients compared with the achieved DNSIYC sample (excluding the Healthy Start (HS) boost)[1]. Weighting factors were applied to correct for over-sampling Scottish cases (designed to allow for a separate analysis in Scotland, which is reported elsewhere), thus making the sample comparable with the population. Non-response weighting factors were not applied for this comparison. Healthy Start recipients selected as part of the HS boost are excluded from this table and are discussed later.

The profile of the achieved sample was very close to that of the population of infants and young children achieved from CB records in the UK. This suggests no large biases have been introduced by sampling error or non-response and that the core sample was representative of the target population.

When the final weighting factors were applied the small variations between the two profiles were reduced and the two distributions were brought closer still. This is shown in Appendix B.

Table 3.1.1

Although 98 participants were selected as part of the HS boost, five of these were excluded from the HS analysis because they were not registered to receive the HS vouchers. These five children were, however, included within the UK sample. The remaining 93 HS recipients were combined with the other 487 HS recipients within the rest of the UK sample for analysis. The profile of the achieved participants selected from the HS database[2] was compared with population figures; this is shown in Table 3.1.2. The two distributions were generally close, although there were some discrepancies (for instance, a higher percentage of mothers aged 20 to 24 years). This is likely to be due to the small sample sizes involved. The small sample size means the sampling error has more impact on the distribution. The discrepancies were not large enough to suggest that the sample was biased.

Table 3.1.2

3.1.2. The achieved sample compared to those who opted out

There were 172 opt-outs in total (4% of the total sample); 106 parents (2%) opted out of the survey prior to fieldwork, a further 66 (1%) opted out once fieldwork had begun[3]. Of these, 169 were selected from the Her Majesty's Revenue and Customs

(HMRC) CB records and were not part of the HS boost. The profile of these parents was compared with that of the achieved sample and is shown in Table 3.1.1.

Fewer younger parents tended to opt out of the survey compared to parents aged between 25 to 40 years; 13% of the parents who opted out were aged under 25 years, compared with 19% of the achieved individuals' parents and 22% of the population of this age. However, this difference was offset by refusals in the field, as younger parents tended to refuse later, once they had been contacted by an interviewer. Any differences in other characteristics were not significant.

When non-response weighting factors were applied, differences in participant profiles were corrected. The weighting factors are discussed in Appendix B.

Table 3.1.1

3.2. Response rates

This section describes response rates for Stage 1 and Stage 2 of DNSIYC fieldwork.

3.2.1. Individual level response to Stage 1 – UK core sample

Of the 4,451 children sampled from CB Records, 97% were eligible to take part in the survey. Ineligible cases included those where the selected child had a birth weight of less than 2kg, had used a feeding tube at or after one week of age, no longer lived at the sampled address, had died, or was aged 18 months or older at the time of interview. Four per cent of eligible cases opted out of the survey either by phone call or letter (2% before fieldwork and 1% during fieldwork). These cases were either not issued to interviewers or not approached at the doorstep.

Of those eligible to take part, 62% were fully productive, i.e. three or four dietary recording days were completed. This gave a sample size of 2,683 fully productive participants.

Table 3.2.1

3.2.2. Individual level response to Stage 2 – UK core sample

Forty four per cent (i.e. 973) of fully productive participants attended a clinic[4].

Skinfold thickness measurements were achieved for 43% of fully productive participants (98% of those who attended a clinic).

A blood sample was provided by 24% of fully productive participants (55% of those who attended a clinic).

The stable isotope component of the study was undertaken by 38% of fully productive participants (87% of those who attended the clinic).

Table 3.2.2

3.2.3. Summary of response to stages in DNSIYC

Figure 3.A below details the number of children who completed each stage and component of the survey. See Chapter 2 for details of the methodology.

Figure 3.A. Summary of response to stages in DNSIYC

UK sample (n=2683)

Included:

- UK core sample (n=2135)
  - England
  - Scotland
  - Wales
  - Northern Ireland
  - Healthy Start recipients (n=487)
- Healthy Start boost sample (n=93)
- Scotland boost sample (n=455)

Stage 1

Measure	CAPI [1]	Food diary	Weight	Length	Head circumference	Maternal height	Maternal weight
n	2683	2683	2580	2391	2422	2607	2581

Stage 2 (n=973)

Measure	Length	Weight	Head circumference	Tricep skinfold	Subscapular skinfold	FBC [2] result	Serum result	Maternal height	Maternal weight
n	959	968	944	955	950	496	466	911	917

Note: all measurements were optional

[1] Computer Assisted Personal Interview

[2] Full blood count (full or partial)

3.3. The child and their environment

The results presented in this chapter derive from the Computer Assisted Personal Interview (CAPI). This section describes some of the background characteristics of the infants and young children in DNSIYC and the households in which they lived.

The survey is based on 2,683 infants and young children for whom parents answered questions and provided dietary information. Results in this section are based on data that have had weighting factors applied for different selection probabilities of boost sample members and non-response to the individual questionnaire as indicated in Chapter 2 (to better reflect the UK population).

Comparisons by age in Chapter 3 were tested at the 95% significance level and only statistically significant differences are highlighted in the text.

3.3.1. Age and Sex

When weighting factors were applied, the final proportions of children in the four age groups studied were 11% of children aged 4 to 6 months, 26% aged 7 to 9 months, 16% aged 10 to 11 months and 47% aged 12 to 18 months. The proportions of children of each sex in each age group were very similar.

Table 3.3.1

3.3.2. Age at Stage 1 and Stage 2

The proportions of children of different ages were rather different between Stage 1 (the home interview) and Stage 2 (the clinic visit) of the survey (refer to sections 2.4 and 2.5 and Appendix A for details of the DNSIYC stages). Only 1% of children were aged between 4 and 6 months at the time of the clinic visit (Stage 2) compared to 11% at Stage 1, while 62% were aged 12 months or over compared to 47% aged 12 to 18 months at Stage 1.

These differences are due to the ageing of the sample between Stage 1 and Stage 2, as the average length of time between the stages was 66 days, so that a number of children fell into a different age group at Stage 2 than at Stage 1. The difference in the age distribution between the two stages is due to this rather than differential response to Stage 2 by age of child. There were also a small number of children who were aged close to 18 months at Stage 1 and were therefore more than 18 months at Stage 2. These children were still included in Stage 2 and the age category is expressed as 12 months or over.

When describing children's ages in this chapter the age discussed is the age at Stage 1, unless otherwise stated.

Table 3.3.2

3.3.3. Household structure

In 46% of cases, the surveyed child was the only child in the family; 32% were one of two children, 14% were one of three and 7% were one of four or more. Forty eight per cent of children surveyed were their mother's first child. Ninety eight per cent were single births.

Table 3.3.3

3.3.4. Ethnicity

Overall, 82% of children were white, 8% were Asian, 3% were black, and 7% were mixed or other. This is largely in line with the UK population as a whole, though DNSIYC figures are slightly lower for white (82% compared with 86% in the 2011 Census) and slightly higher for mixed or other (7% compared with 3% in the 2011 Census)[5].

Table 3.3.4

3.3.5. Region

Eighty five per cent of children lived in England, 4% in Wales, 7% in Scotland and 3% in Northern Ireland. This is in line with the population demographics published by the Office of National Statistics in the 2010 population estimates[6]. Refer to Table 3.3.5 for national data.

Table 3.3.5

3.3.6. National Statistics Socio-economic Classification (NS-SEC) and housing tenure

Twenty three per cent of children lived in a household where the Household Reference Person (HRP) was in a lower managerial and professional occupation, and around 15% in each of the following categories; higher managerial and professional, semi-routine and routine occupations. Smaller proportions of HRPs were in other types of occupation, had never worked, were unemployed, or were not classified. When compared to the 2011 Census, DNSIYC figures are slightly higher for managerial and professional occupations (16% compared with 10% in the 2011 Census) and slightly lower for intermediate occupations (9% compared with 13% in the 2011 Census) but, overall, proportions are generally in keeping with the general UK population[7].

Overall, 47% of HRPs owned their own homes with a mortgage and 46% were in rented accommodation. Very small proportions were in other types of accommodation, such as owning outright, shared ownership or living rent-free.

Table 3.3.6

3.3.7. Household smoking and drinking

For 65% of children, no one in the household smoked, with little variation with age of child. For 22% of children, the interviewee smoked; the interviewee was usually, but not always, the mother; for another 18% of children, the interviewee's partner smoked and for 5%, someone else in the household smoked.

In 74% of households, someone in the household drank alcohol; for 62% the interviewee drank alcohol, for 53% the interviewee's partner drank. None of these proportions varied with the age of the child.

Table 3.3.7.1 and 3.3.7.2

3.3.8. Healthy Start voucher recipients

HS vouchers were received in 21% of the responding households with little variation with the age of the child. This is in line with estimated uptake for children of this age in the general UK population.

Of the households receiving HS vouchers, 47% spent all or most of their vouchers on infant formula (see Annexe A for more details on the use of HS vouchers). This varied by age of the child from 69% for children aged 4 to 6 months and 65% for those aged 7 to 9 months, decreasing to 53% for children aged 10 to 11 months, and 29% for those aged 12 to 18 months. Twenty five per cent of vouchers were only or mainly spent on fruit and vegetables, increasing with age of child from 13% for children aged 4 to 6 months, 17% for those aged 7 to 9 months, 24% for those aged 10 to 11 months and 34% for those aged 12 to 18 months. For much smaller proportions of households vouchers were spent only or mainly on cow's milk (9% overall), or on mixtures of fruit and vegetables and infant formula or cow's milk, or on supplements. In 3% of households receiving vouchers, the vouchers were received but not used.

Tables 3.3.8.1 and 3.3.8.2

3.3.9. Child care

In 44% of households it was reported that no one other than the parents (in the household) looked after the child. For 34% of children, grandparents provided

childcare; 14% of children overall went to a day nursery; and smaller proportions of households used other types of childcare (1% to 9%).

In the week preceding the interview, children spent an average of 8.8 to 20.2 hours per week in the different forms of childcare.

Of children receiving childcare, the majority (77% to 86% overall) received meals when in childcare. Children looked after in a nursery, crèche or playgroup were more likely to be offered water (82%) and less likely to be offered squash (8%) than those looked after by relatives (62% and 27%) or by a childminder, babysitter or other unrelated carer (62% and 21%).

Tables 3.3.9.1 to 3.3.9.4

3.3.10 Neurological developmental

Children showed development in terms of picking up objects, sitting, crawling, standing, walking and speech, as expected with increasing age.

Table 3.3.10.1 to 3.3.10.3

3.3.11. Teeth

At the time of the survey the proportion of children with no teeth decreased with age from 75% of those aged 4 to 6 months to 1% of those 12 to 18 months. The number of teeth increased with age so that for children aged 12 to 18 months, the largest proportion (42%) had five to eight teeth.

The age the first tooth was reported to have appeared varied widely. The most common age was six months (22%), but in 3% to 4% of children the first tooth appeared either before three months of age or after 12 months.

The Department of Health (DH) recommends that tooth brushing twice a day should begin as soon as teeth begin to appear[8]. A toothbrush was reported to be used at least once every day for 66% of children with at least one tooth. This ranged from 46% of children with one to four teeth to 87% for children with 13 teeth or more. For 19% of children with at least one tooth, a toothbrush was never used.

Tables 3.3.11.1 to 3.3.11.3

3.3.12. Advice about diet and feeding

The parents of only a small proportion of children (5%) had received any advice from a dietitian on feeding their child. Where advice had been given, the most common advice was related to allergy or intolerance (40%), whilst 28% received advice on

specialised formula for allergy or intolerance. In 29% of cases advice was provided in relation to insufficient milk or food consumption for adequate growth. For small proportions of children advice was received about general problems in introducing complementary foods, constipation, specialised formula for conditions other than allergy or intolerance, over consumption of milk or food, reflux, and other conditions.

Tables 3.3.12.1 and 3.3.12.2

3.3.13. Medications

At the time of the survey only 7% of children overall were being given prescribed medications, with little variation with age. The purpose of the medications was evenly distributed for treating the gastrointestinal system, respiratory system, central nervous system, infections and other conditions.

Table 3.3.13

3.3.14. Health problems and hospital visits

Overall, since birth 72% of children had had a health problem necessitating consultation with a health professional (General Practitioner (GP), health visitor, National Health Service (NHS) direct or hospital). Thirteen per cent required admission to hospital. Respiratory infections were particularly common.

Tables 3.3.14.1 and 3.3.14.2

3.3.15. Bowel habit

All children were still wearing nappies at the time of the survey. Parents reported that most children (65%) had a dirty nappy[9] two to three times a day with little variation with age. Fewer children had a dirty nappy less often (20% once a day and 3% once in two to four days) or more often (12% four or more times per day). Significantly less frequent dirty nappies were seen for older children with 25% of those aged 12 to 18 months having a dirty nappy just once a day compared with 16% of those aged 4 to 6 months and 7 to 9 months.

Table 3.3.15

3.3.16 Sun exposure

Children in DNSIYC were born between the months of August 2009 and November 2010. Interviews were carried out between January and May 2011, so children born in the autumn and early winter of 2010 were unlikely to have experienced any summertime sunshine in their lifetime at the time of the interview. Details of sun exposure given below and in the tables should therefore be interpreted in light of the opportunities for sun exposure.

In the seven days prior to the survey interview, 5% of children overall had not been outside between 10am and 3pm at all, with little variation with age. Forty five per cent had been outside between these hours every day. Much smaller proportions of children (4% to 11%) had been outside on one to six days.

Most children (83%) who spent time outside in the seven days before the interview usually spent three hours or less outside each day.

In the 12 months prior to the survey 30% of children had been on a holiday or a trip to a sunny place for more than two days. This increased steadily with age from 7% for those aged 4 to 6 months to 38% for those aged 12 to 18 months.

The three main precautions that were taken when children were exposed to strong sun were trying to keep the child in the shade as much as possible (34% of all children), using sun cream (33%) and covering the child up as much as possible (31%). Twenty four per cent limited the amount of time the child spent outdoors.

Tables 3.3.16.1a to 3.3.16.4

3.4. Maternal characteristics

This section describes a number of characteristics of the mothers of the children in the survey and seeks to explore factors specifically associated with the mothers that may have an influence on the diet and health of the child.

3.4.1. Age

The mothers of DNSIYC participants ranged in age from 16 to 52 years[10], with a mean (and median) age of 30 years. Fifty five per cent of mothers were between the ages of 25 and 34 years, with the remainder evenly distributed below and above this age range. There were only 76 mothers (3% of the total) below the age of 20 years and hence for the characteristics described below, this small number should be borne in mind.

Table 3.4.1

3.4.2. Height and weight

Two per cent of mothers had a body mass index (BMI) of less than 18.5, 47% had a BMI between 18.5 to 25, 29% between 25 and 30 and 22% above 30. Women take varying lengths of time to lose any weight gained during pregnancy and interpretation of results for BMI calculated from weights taken post pregnancy should take this into account.

Table 3.4.2

3.4.3. Marital status

Just over half (54%) of the mothers of DNSIYC participants were married and living with their husband whilst 26% were not married but living with a partner. Seventeen per cent were single (i.e. not living as a couple and had never been married). There was variation with age, with 3% of mothers under 20 years being married compared with 64% or over for mothers aged 30 years or over.

Table 3.4.3

3.4.4. Ethnicity

Overall, 82% of mothers were white, 8% were Asian, 3% were black and 7% were mixed race or 'other'.

Table 3.4.4

3.4.5. Education

Overall, 89% of mothers had some kind of qualification[11]. Thirty three per cent were educated to degree level or above. This compares to figures for women of a comparable age group with at least one child from the Understanding Society survey, which found 22% were educated to degree level or above and 15% had no qualification. These differences may be explained by differences in methods used in the two surveys, or may represent real differences observed in education levels of women surveyed[12].

Table 3.4.5

3.4.6. Smoking and drinking

Around half of mothers (52%) reported that they had ever smoked. This proportion was higher in the younger age groups ranging from 77% of those aged under 20 years, to around 50% of those aged above 25 years. In total, 26% of mothers reported smoking in the three months before they knew they were pregnant, which reduced to 17% reporting they smoked after they knew they were pregnant. Overall, 22% of mothers reported that they smoked at the time of the survey. This proportion also decreased with age from 55% of those aged under 20 years to 15% or less for those aged 30 years or over.

Overall, 62% of mothers reported drinking alcohol at the time of the survey. In contrast to smoking, this proportion increased steadily with age from 48% of mothers aged under 20 years to 71% of those 35 years or over. Forty eight per cent of mothers overall reported drinking alcohol in the three months before they knew they were pregnant. This increased with age from 39% of those under 20 years to 55% of

those 35 years or over. Twenty five per cent of mothers reported consuming alcohol once they knew they were pregnant. This also increased with age, the lowest proportions being in those aged under 20 years and 20 to 24 years, and the highest in those aged 35 to 39 years, where 37% of mothers reported drinking when they knew they were pregnant. The number of units of alcohol consumed was not collected. Women who are pregnant or planning to get pregnant are advised to avoid alcohol, due to the potential risk to the unborn child. If women do decide to drink during pregnancy they should not drink more than one or two units of alcohol once or twice a week[13].

Tables 3.4.6.1 and 3.4.6.2

3.4.7. Dietary habits at the time of the interview

A small proportion of those interviewed were not the mothers of the children and they are not included in this section.

Overall, the diets of older mothers were healthier than younger mothers. Those mothers aged 35 years or over tended to eat breakfast more often, to eat fruit and vegetables more often, were more likely to consume semi-skimmed or skimmed milk, and to eat crisps less often than younger mothers. They were also more likely to eat wholemeal and brown bread rather than white, to eat oily fish more often and to use olive oil for cooking than younger mothers. However, they ate cakes more frequently than younger mothers.

3.4.7.1. Usual dietary habits

Of the mothers in the survey 62% reported eating breakfast every day. This proportion increased with age, rising from 29% of those aged under 20 years to over 70% for those aged 30 years or over. The proportion of mothers who never ate breakfast decreased with age, from 28% of those aged under 20 years to less than 8% of those aged 30 years or over.

Table 3.4.7.1.1

Table 3.4.7.1.2 illustrates consumption of various foods including fruit and vegetables, dairy products, crisps, cakes and sweets reported by mothers in DNSIYC. Overall 60% of mothers reported eating fruit and 73% reported eating vegetables at least once a day and the proportion increased with mother's age. Only 5% overall reported never eating fruit and 2% eating vegetables less than one to three times per week. These proportions decreased with age.

Tables 3.4.7.1.3 to 6 illustrate the types of drinks consumed and tables 3.4.7.1.7 to 11 illustrate the types of bread and fats consumed by mothers in DNSIYC.

Tables 3.4.7.1.2 to 3.4.7.1.11

When asked about eating oily fish, 58% of mothers reported that they 'never' ate tinned oily fish. Those who did eat tinned oily fish did so infrequently, with 30% eating it one to three times a month or less often. Only 12% reported eating tinned oily fish at least once a week and only 1% did so at least three times per week. Overall 37% of mothers reported that they 'never' ate fresh or frozen oily fish while 28% reported eating fresh or frozen oily fish at least once a week. Older mothers ate both tinned and fresh or frozen oily fish more often than younger mothers.

Table 3.4.7.1.12

Very similar proportions of mothers either 'always' (28%) or 'never' (27%) added salt to their food, with smaller proportions saying that they added salt 'often', 'sometimes' or 'rarely'. There was little variation with age.

Table 3.4.7.1.13

Fresh fruit was reported to be 'always' available in the home by 82% of mothers, and was more likely in older than younger mothers. Only 1% of mothers reported that they 'rarely' or 'never' had fresh fruit available in the home, although for mothers aged under 20 years, this proportion was 9%. Similarly, 77% of mothers reported that fresh vegetables were 'always' available in the home, and the youngest age groups were again those with a greater likelihood of 'rarely' or 'never' having fresh vegetables available (11%).

Table 3.4.7.1.14

3.4.7.2. Awareness of dietary recommendations for adults

Overall, 83% of mothers were aware that the recommended minimum number of fruit and vegetable portions that should be consumed each day was five, with little variation with age. Small proportions thought the number of portions recommended was higher (3%), lower (9%) or did not know (5%) what the recommendations were.

Only 12% of mothers were aware that the maximum recommended amount of salt to be consumed each day was 6g. Thirty per cent thought the maximum daily recommendation was less than 6g, 6% thought more than 6g and 52% reported they did not know.

Overall, 11% of mothers were aware of the recommendation to aim to eat at least one portion of oily fish each week. Fifty eight per cent thought the recommendation was higher than this and 30% did not know.

Table 3.4.7.2

3.4.7.3. Use of dietary supplements

Forty six per cent of mothers reported taking any type of dietary supplement and this increased with the age of the mother. The most common supplement taken was a multi-vitamin and mineral (27% of mothers took these). Supplement taking was more common among mothers aged 35 or over compared with younger mothers. Mothers were not asked about supplement use in pregnancy. For details of the supplement use in children in DNSIYC refer to section 6.3.

Table 3.4.7.3

References and endnotes

[1] The 2,585 individuals included in this comparison were selected from CB records. The 98 individuals selected within the HS boost sample were not selected from CB records and are therefore not included in this comparison. They were, however, included in the dietary analysis presented throughout this report, as application of the final weighting factors (see Appendix B for an explanation of the weighting factors) ensured the combined core and HS boost sample was representative of the UK population.

[2] In order to compare like with like, the participants selected from HS were compared to the HS population. The five cases dropped from the sample have been included as it would not have been possible to identify corresponding cases in the population.

[3] Parents opted out of the survey by contacting the NatCen offices, prior to the interviewer making contact.

[4] There was no Stage 2 in the Scotland boost and so Scottish boost participants are excluded from any analyses related to response to Stage 2.

[5] 2011 Census. Available online: http://www.ons.gov.uk/ons/guide-method/census/2011/index.html

[6] UK National Statistics: 2010 Population Estimates: total persons for United Kingdom and constituent countries; estimated resident population can be found online: http://www.statistics.gov.uk/hub/population/population-change/population-estimates/index.html

[7] 2011 Census: Table KS611EW NS-SEC, local authorities in England and Wales. Available online: http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-286262

[8] Department of Health, Delivering Better Oral Health (2nd edition 2009). Available online at: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_102982.pdf

[9] A dirty nappy refers to faeces being present in the nappy.

[10] The oldest mother, at age 52, was an adoptive mother.

[11] Qualifications were defined as degree level or above, or an educational, professional, vocational or other work-related qualification for which a certificate was received.

[12] Understanding Society, Wave 1 (2009-2010), unpublished.

[13] Department of Health (2006) How much is too much? Pregnancy and Alcohol. Online at: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_080105.pdf

Chapter 4 Physical measurements

Summary of findings

- Boys and girls in Stages 1 and 2 of the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) were, in general, taller (longer), heavier and had larger head circumferences than the UK World Health Organisation (UK-WHO) Growth Standard for their age and sex.

- Boys and girls in Stage 2 of DNSIYC had a larger subscapular skinfold thickness than the UK-WHO Growth Standard. The youngest and oldest age groups had larger triceps skinfold thicknesses and children aged 10 to 11 months had smaller triceps skinfold thicknesses than the UK-WHO Growth Standard for their age and sex.

4.1. Introduction

Physical measurements were carried out at Stage 1 (in participant's home) and again at Stage 2 (in clinic) only for those attending the clinic. See Chapter 2 and Appendix A for details of these stages. For Stage 1, results are presented by age at the Computer Assisted Personal Interview (CAPI) and for Stage 2 by age at the clinic visit. Weight, length and head circumference measurements were taken at Stage 1; at Stage 2 the same measurements were recorded, in addition to body composition measurements, namely skinfold thickness. No statistical testing has been done in Chapter 4 between Stage 1 and 2 measurements because of the time lapse between the two measurements and therefore differences mentioned here are only observations.

Revised UK World Health Organization (UK-WHO) growth charts for birth to two years were introduced for all new births in England, Wales and Northern Ireland from May 2009 and in Scotland from January 2010. These are based on UK-WHO Growth Standards from data in children who were exclusively or predominantly breastfed[1,2]. Predominantly formula fed children are on average larger for their age compared to exclusively or predominantly breastfed children on which these standards are based.

4.2. Results

4.2.1. Stage 1 – weight, length and head circumference

Of the 2,683 fully productive children at Stage 1, valid length was achieved for 89%, weight for 96% and head circumference for 90% of these children. According to standard practice, a measurement was deemed invalid if either a) the derived sex- and age-adjusted UK-WHO Z-score[3] was below -6 or above +6 or b) in the opinion of the interviewer, the measurement taken was unreliable.

The mean length of all boys in the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) was 76.5cm; that is 69.4cm for those aged 4 to 6 months, 73.3cm for those 7 to 9 months, 76.4cm for those 10 to 11 months, and 80.3cm for children aged 12 to 18 months. When compared with the UK-WHO Growth Standard for their age and sex, 66% of boys aged 4 to 6 months, 76% aged 7 to 9 months, 77% aged 10 to 11 months and 66% aged 12 to 18 months were above the 50th percentile.

The mean length of all girls was 75.1cm; that is 67.6cm for those aged 4 to 6 months, 71.5cm for those 7 to 9 months, 74.7cm for those 10 to 11 months, and 79.1cm for children aged 12 to 18 months. The proportion of girls in DNSIYC above the 50th percentile for length was similar to boys; 72% of girls aged 4 to 9 months and 12 to 18 months and 77% of those aged 10 to 11 months.

For all boys in DNSIYC the mean weight was 10.3kg; 8.4kg for those aged 4 to 6 months, 9.6kg for those aged 7 to 9 months, 10.2kg for those aged 10 to 11 months, and 11.2kg for boys aged 12 to 18 months. When compared with the UK-WHO Growth Standard for their age and sex, 59% of boys aged 4 to 6 months and at least 75% of those aged seven months or over were above the 50th percentile for weight.

For all girls the mean weight was 9.6kg; 7.8kg for those aged 4 to 6 months, 8.6kg for those aged 7 to 9 months, 9.4kg for those aged 10 to 11 months, and 10.6kg for those aged 12 to 18 months. The proportion of girls in DNSIYC above the 50th percentile for weight was 66% of those aged 4 to 6 months rising to 78% of those aged 12 to 18 months.

For all boys in DNSIYC the mean head circumference was 46.8cm. For boys aged 4 to 6 months mean head circumference was 44.4cm, 46.1cm for those 7 to 9 months, 46.7cm for those aged 10 to 11 months, and 47.9cm for those 12 months and over. When compared with the UK-WHO Growth Standard for their age and sex, 75% of boys aged 4 to 6 months were above the 50th percentile, 85% for 7 to 9 months, 76% for 10 to 11 months and 77% for 12 to 18 months.

For all girls in DNSIYC the mean head circumference was 45.6cm. For girls aged 4 to 6 months mean head circumference was 43.3cm, 44.6cm for 7 to 9 months, 45.5cm for 10 to 11 months, and 46.8cm for 12 to 18 months. When compared with the UK-WHO Growth Standard for their age and sex, 75% of girls aged 4 to 6 months, 77% of those 7 to 9 months, 72% of those 10 to 11 months, and 84% of those aged 12 to 18 months in DNSIYC were above the 50th percentile.

Table 4.1a

4.2.2. Stage 2 – weight, length, head circumference and skinfold thicknesses

Overall, 973 children attended a clinic visit (Stage 2). A valid length and weight measurement was achieved for 99% of these children, head circumference

measurement for 97% and skinfold thickness measurements for 98%. In about 1% of children, the attempt to take any of the physical measurements was unsuccessful. A weight, length and head circumference measurement was deemed invalid if the derived sex- and age-adjusted UK-WHO Z-score was below -6 or above +6. A triceps and/or subscapular skinfold thickness measurement was deemed invalid if the derived sex- and age-adjusted 2006 WHO Z-score[4] was below -6 or above +6.

Mean length, weight and head circumference for boys and girls in Stage 2 was very similar to that in Stage 1, see Table 4.1b.

For all boys attending the clinic visit in DNSIYC, the mean subscapular skinfold thickness was 7.2mm. The means were very similar across the age groups (7.1mm for those aged 5 to 9 months and rising to 7.2mm for both those aged 10 to 11 months and 12 to 18 months). When compared with the UK Growth Standard for their age and sex, 55% of boys aged 5 to 9 months were above the 50th percentile, rising to 67% of those aged 12 months or over.

For all girls attending the clinic visit in DNSIYC, the mean subscapular skinfold thickness was 7.6mm; that is 7.7mm for those aged 5 to 9 months, 7.8mm for 10 to 11 months, and 7.5mm for 12 to 18 months. When compared with the 2006 WHO Growth Standard for their age and sex, 62% of girls aged 5 to 9 months were above the 50th percentile, rising to 69% of those aged 12 months or over.

For all boys attending the clinic visit in DNSIYC, the mean triceps skinfold thickness was 8.1mm ranging from 8.6mm for those aged 5 to 9 months, to 7.9mm for 10 to 11 months, and 8.1mm for 12 to 18 months. When compared with the 2006 WHO Growth Standard for their age and sex, 53% of boys aged both 5 to 9 months and 12 months or over were above the 50th percentile and 46% of those aged 10 to 11 months.

For all girls attending the clinic visit in DNSIYC, the mean triceps skinfold thickness was 8.4mm ranging from 8.8mm for 5 to 9 months, to 8.0mm for 10 to 11 months, and 8.4mm for those aged 12 months or over. When compared with the 2006 WHO Growth Standard for their age and sex, 52% of girls aged 5 to 9 months were above the 50th percentile, 45% of those 10 to 11 months and 61% of those aged 12 months or over. There were a greater proportion of girls above the 50th percentile than boys for those aged 12 months or over.

As shown in Table 4.1a and b, more than 50% of children within the DNSIYC sample exceeded the 50th percentiles for growth compared to the 2006 WHO growth standard for their age and sex. This might be partially explained by the predominance of formula feeding by this group at the time of the survey, while the growth standards are based on exclusively or predominantly breastfed children.

Table 4.1b

4.2.3. Body composition

Body composition could not be adequately assessed from the stable isotope methodology. The method requires accurate assessment of lean body mass from the dilution of a known quantity of stable isotope in the body and there were some difficulties with the analysis because of losses due to spillage, dribbling and posseting which made it challenging for the assessment of body composition. Results for body composition assessed from the stable isotope methodology are therefore not presented in this report.

References and endnotes

[1] Royal College of Paediatrics and Child Health/World Health Organisation. The UK_WHO_Growth Charts: Early Years. London: RCPCH, 2009 Available online: http://www.rcpch.ac.uk/growthcharts

[2] The new UK-WHO 0-4 years Growth Standards were introduced in the UK because they represent an international standard of growth for infants and young children in good health who were exclusively or predominantly breastfed for at least four months. The new charts were constructed using the WHO Growth Standards for infants aged two weeks to four years, which used data from children from around the world with no known health or environmental constraints to growth. WHO Growth Standards represent a pattern of linear growth, which is remarkably consistent between different countries and ethnic groups following recommended feeding practices. They are applicable to all children in the UK, including those from ethnic minority groups. The WHO data are combined with birth data for gestations 23 to 42 weeks from the UK 1990 growth reference for various reasons.

[3] The Z-score classification system is a means to interpret weight-for-height, height-for-age and weight-for-age. The Z-score (standard deviation scores) is widely recognised as the best system for analysis and presentation of anthropometric data. The Z-score system expresses the anthropometric value as a number of standard deviations or Z-scores below or above the reference mean or median value.

[4] http://www.who.int/childgrowth/standards/en/

Chapter 5 Feeding practices

Summary of findings

- The proportion of children in the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) who had been breastfed, the duration of breastfeeding, and the frequency of feeding through the day for those being breastfed at the time of the survey were similar in DNSIYC to the Infant Feeding Study of 2010. Of those who were breastfed, the majority of children (57%) were not breastfed beyond three months of age. Twenty two per cent had never been breastfed.

- Formula and breast milk were the drinks most often given to the majority of younger children, whereas for over a third of those aged over 12 months (36%), cow's milk was most frequently provided, followed by formula (for 24%) and water (for 17%). Few younger children were given other drinks more frequently than formula or breast milk, but the drinks provided most often to some older children were squash, juice or flavoured water.

- Ten per cent of children were first given food other than milk before the age of three months, 75% at five months or under, 22% at six months and 3% at seven months or over.

- Baby rice was the most common first food for children in DNSIYC (65%), pureed fruit or vegetable was also popular as a first food (21%). Other foods, such as yoghurt or finger foods were the first food for small proportions of children.

- Children in DNSIYC showed a progression with age in ability to eat pureed foods, lumpy foods and finger foods, drink from a cup or beaker with a spout, and use a spoon. Most children eating food with lumps or unblended or unmashed, began to eat these at 7 to 9 months (55%), but a substantial proportion (32%), began to eat these at 4 to 6 months or younger.

- Most of the children who had food other than milk 'almost always' (28%) or 'sometimes' (31%) had the same food as their parents, or 'sometimes' had a different meal to, but prepared by, their parents (41%). However, a substantial proportion (24%) never had the same food as their parents, although this was more common for younger children.

- The majority of children (58%) who had food other than milk had eaten a commercial baby or toddler meal. Twenty per cent of children who had food other than milk had eaten a commercially prepared adult ready meal.

- For those children who had food other than milk, most parents (83%) 'never' added salt to the child's food.

- There was a moderate correlation between estimates of breast milk intake obtained from breast milk diaries compared to stable isotope methods. Mean daily intakes estimated from the diary were 450g, 380g, 430g for children aged 4 to 9 months, 10 to 11 months and 12 to 18 months respectively. Mean intakes estimated from stable intakes estimated from stable isotope methods were 470g, 350g and 400g respectively.

5.1. Introduction

The results presented in this chapter derive from the Computer Assisted Personal Interview (CAPI). This chapter describes the practices used in feeding the children in the Diet and Nutrition Survey of Infants and Young Children (DNSIYC). When describing children's ages in this chapter the age discussed is the age at Stage 1, unless otherwise stated.

Comparisons by age in Chapter 5 were tested at the 95% significance level and only statistically significant differences are highlighted in the text.

5.2. Milk and drinks

5.2.1. Breastfeeding

Overall, 78% of children were reported to have ever been breastfed, with little variation with age. This compares with the Infant Feeding Survey (IFS) in 2010[1] where 76% were reported to have been breastfed initially. Overall 22% of children had never been breastfed. For those children no longer being breastfed, most (57%) consumed their last breast milk at three months or under, and a further 22% had their last breast milk between 4 and 6 months. Only a small proportion of those who were no longer being breastfed had stopped at 12 to 18 months (4%).

The DNSIYC sample included children ranging in age from four months to 18 months. Hence the older children were likely to be having breast milk less frequently than the younger children, as foods are introduced. As expected, the proportion of children still receiving breast milk decreased with age from 30% of those aged 4 to 6 months to 8% of those aged 12 to 18 months. For those being breastfed at the time of the survey, 99% were breastfed at least once a day. For those aged 4 to 6 months, 39% were fed five to six times a day, with about 30% fed more and 30% fed less than this. For those aged 7 to 9 months and 10 to 11 months, the greatest proportion (over 40%), were fed three to four times a day, with smaller proportions fed more or less often. For those aged 12 to 18 months who were still breastfeeding, 50% were fed one to two times a day, with smaller proportions fed more frequently. Overall 5% of children were reportedly fed nine times or more each day[2].

Tables 5.2.1 to 5.2.3

5.2.2. Use of formula

The proportion of children being given any type of infant formula in DNSIYC at the time of the survey was 87% to 89% for those aged 4 to 11 months and 38% for those aged 12 to 18 months.

Powdered infant formula is not sterile and can become contaminated with microorganisms, which can cause serious illness. The Department of Health (DH) therefore provides guidance about the safe preparation, storage and handling of infant formula[3]. These are referred to as formula preparation recommendations in this report.

The large majority of parents made up the formula as needed (72% to 81%), in line with recommendations, however 23% of parents of those aged 4 to 6 months made up several feeds at once. There were significantly lower proportions of parents who reported doing this for children aged seven months or over. When making up formula, 68% of parents overall used water that had been boiled and left to cool for no longer than 30 minutes as recommended, with 32% using water that had boiled but left for longer than 30 minutes.

Tables 5.2.4 to 5.2.6

When parents were asked about feeding their child infant formula away from home, 12% with children aged 10 to 11 months and 29% with children aged 12 to 18 months reported 'never' feeding their child infant formula when away from home, with significantly smaller proportions for younger children. Parents of those aged 4 to 6 months were most likely (40%) to make up an infant formula feed before leaving home if the child would be fed while away from home. For older age groups, the formula feed was more likely to be made up while away from home (30% to 39%). Twenty per cent were likely to take a ready to feed formula with them when leaving home. For those aged 4 to 6 months, 8% of parents only breastfed when away from home, with much smaller proportions for the older age groups. Less than 1% of mothers expressed breast milk in preparation for feeding outside of the home.

For those parents who made up formula before leaving home, the majority did not keep the formula chilled, which is not in line with recommendations. This proportion was as high for those aged 4 to 6 months (64%) as for those aged 7 to 9 months (62%) and 10 to 11 months (63%), with slightly fewer parents of those aged 12 to 18 months not keeping the formula chilled (53%). For those who made up the formula while out, the majority made up the formula with cold or cooled water, which is not in line with recommendations. This proportion was 54% for those where the child was 4 to 6 months to over 60% for the other age groups. Hence the proportion making up the feed from hot water as recommended, either obtained while out of the home or having it in a flask, was less than 50% for all age groups.

Tables 5.2.7 to 5.2.9

5.2.3. Drinks given most often

For those children who were reported to be given drinks other than or as well as breast milk, the drink most often given to those under a year old was infant formula (63% for those aged 4 to 6 months, 48% for those aged 7 to 9 months and 35% for those aged 10 to 11 months). Follow on milk was significantly more likely to be given to children aged 7 to 11 months (27% for those aged 7 to 9 months and 28% for those aged 10 to 11 months) than the youngest and oldest age groups (14% for those aged 4 to 6 months and 15% for those aged 12 to 18 months). For the oldest age group, cow's milk was the most frequently given drink (36%), with very small proportions giving this most often in the younger age groups. Twenty two per cent of children aged 4 to 6 months were given breast milk most often. This proportion reduced with age to 3% of children aged 12 to 18 months. For those aged 10 to 11 months and 12 to 18 months, water was the drink given most often to 16% to 17% of children respectively. The proportions given other drinks most often were small although for those aged 12 to 18 months 6% of children were given non-low calorie squash/soft drink most often and 8% were given low calorie squash/soft drink most often.

Tables 5.2.10 and 5.2.11

5.3. Eating patterns

5.3.1. First foods consumed

DH recommends that complementary foods should be introduced at about six months of age[4]. Overall, 99% of children participating in DNSIYC had been given food apart from milk. Of these, 10% of children had food by three months of age, 32% at four and five months, and 22% at six months. A very small proportion of children were given food for the first time aged seven months or over (3%). These proportions can be compared with the 2010 IFS which expressed the ages as cumulative percentages of all mothers who had provided food. In the IFS, 5% of children had received solid food by three months of age, compared to 10% in DNSIYC; 30% had received solid food by four months, compared to 43% in DNSIYC; 75% by five months which was the same in DNSIYC; and 94% by six months, compared to 97% in DNSIYC. In the 2010 IFS, there was a noticeable reduction (to 31%) in the proportion fed solid food by four months compared to previous surveys (51% in 2005[5] and 85% in 2000) although this proportion was higher in DNSIYC (43%). By six months of age, most children had been given solid food in DNSIYC and all IFS surveys.

Table 5.3.1

For children who had been fed complementary foods, the most common type of first food was baby rice, this being the first food in over 60% of cases for all ages. The

second most common was pureed fruit or vegetables, for 22% of children given their first food aged four months or over, and 14% for those given their first food at three months of age or under. Other foods, such as pureed or lumpy meat or fish, finger foods or yoghurt were given to smaller numbers of children as their first food. Those given their first food at six months or over were significantly more likely (5%) than younger ages (1% to 3%) to be given finger foods as their first food, although percentages were small.

Table 5.3.2

5.3.2. Introduction of solids

For children who had been fed complementary foods by 7 to 9 months of age, nearly all (at least 90%) were reported to suck or chew on finger foods. A significantly smaller proportion (49%) of those aged 4 to 6 months did this. Over 70% of those children aged 4 to 6 months usually ate smooth pureed food; for older children, significantly smaller proportions usually consumed their food this way. The majority of those aged 7 to 9 months (71%) and 10 to 11 months (63%) usually ate their food with some lumps, with lesser proportions for those aged 4 to 6 months (27%) and 12 to 18 months (33%). By 12 to 18 months, 65% of children usually ate their food unblended or unmashed. The most common age at which children started having meals with lumps was 7 to 9 months (55%), with 31% starting to have food with lumps aged 4 to 6 months, 10% not until 10 to 11 months and small numbers (1% to 3%) aged three months or under and aged 12 to 18 months.

For 86% of children, parents reported that it was not difficult to introduce solid foods. For the remaining 14% for whom parents did report difficulties, the main reasons given were that the child would not take solids, was disinterested in food, preferred drinks to food, or would only take certain solids. In the IFS, these same four reasons were also common reasons for having difficulty introducing solid foods, although the proportion of children who refused only certain foods was higher in IFS (42%) than in DNSIYC (20%), where there was a greater proportion not taking solids at all.

For children of all ages, the vast majority of parents indicated that their child was 'often' or 'always' interested in food (90%), 'often' or 'always' had a big appetite (68%) and 'never' or 'rarely' took more than 30 minutes to finish a meal (73%). When parents were asked whether the child was full before the meal was finished, about 83% overall indicated that this happened 'never', 'rarely', or 'sometimes', with little variation with age; 17% indicated that this happened 'often' or 'always', with no trend with age.

Tables 5.3.3 to 5.3.8

5.3.3. Meals consumed

For children who had been fed complementary foods, over 90% of those aged 7 months or over ate solid food three or more times per day; for those aged 4 to 6 months, 60% ate solid foods this often. At 4 to 6 months, 10% of children eating complementary food 'always' or 'almost always' ate the same food as their parents. This proportion rose steadily with age such that for those aged 12 to 18 months, 63% of children 'always' or 'almost always' ate the same food as their parents. Conversely 69% of those aged 4 to 6 months 'never' ate the same food as their parents; this proportion decreased with age. However, at 12 to 18 months, 8% of children still 'never' ate the same food as their parents.

Thirty four per cent of children aged 4 to 6 months and 7 to 9 months 'always' or 'almost always' ate a meal prepared by, but different from, their parents. This proportion was significantly lower for the older age groups decreasing to 18% for children aged 12 to 18 months.

For children aged 4 to 6 months, 36% 'always' or 'almost always' ate a commercially prepared baby or toddler meal for the main meal of the day. This proportion steadily decreased with age so that for those aged 12 to 18 months, only 5% 'always' or 'almost always' ate a commercially prepared baby or toddler meal for the main meal. Conversely 28% of those aged 4 to 6 months and 7 to 9 months 'never' ate a commercially prepared baby or toddler meal for the main meal, rising with age to 56% for those aged 12 to 18 months. Very few of those aged 4 to 6 months and 7 to 9 months (3% and 8%) had ever eaten a commercially prepared adult ready meal. This proportion increased with age to 16% for those aged 10 to 11 months and 32% for 12 to 18 months. For 98% of children aged 4 to 6 months, parents had 'never' added salt to their food, including in cooking. This proportion decreased with age but remained high, such that for those aged 12 to 18 months, 75% of parents had 'never' added salt to their child's food.

Tables 5.3.9 to 5.3.14

5.3.4. Foods avoided

For children who had been fed complementary foods, 37% of parents overall had avoided giving certain foods to their children. This proportion increased with age from 18% for those aged 4 to 6 months to 43% for those aged 12 to 18 months. Of those avoiding giving certain foods, the most commonly avoided food was nuts (40%), followed by all meat, poultry, fish, seafood and offal (33%), spicy foods (27%), sweets and chocolate (24%), all eggs and dairy (22%) and processed foods (21%). Other foods were mentioned by smaller numbers, such as salad vegetables, fresh fruit and wheat. Reasons for avoiding giving certain foods are provided in Tables 5.3.17 to 5.3.20.

Tables 5.3.15 to 5.3.20

5.4. Developmental feeding practices

DH recommends that from about six months mothers start to introduce children to drinking from cups and beakers. This helps to reduce bottle use and thereby reduces the risk of tooth decay[6]. The proportion of children who had ever drunk from a cup or beaker with a spout increased with age, from 47% of those aged 4 to 6 months, rising steadily to 95% of those aged 12 to 18 months. The proportions were broadly similar in DNSIYC to the 2010 IFS, 54% of children had used a cup or beaker with a spout in the IFS by six months of age, compared to 53% in DNSIYC, and 81% by nine months, compared to 85% in DNSIYC.

For those aged 4 to 6 months who drank from a cup or beaker with a spout in DNSIYC, the majority of children (73%) drank this way 'sometimes', with a smaller proportion (22%) drinking this way 'usually'. These frequencies steadily changed with age, such that by 12 to 18 months, 70% 'usually' drank from a cup or beaker with a spout and 27% doing so 'sometimes'.

Of those children who had been given food other than milk, 45% of those aged 4 to 6 months could feed themselves a rusk or similar food. This figure increased to 88% of those aged 7 to 9 months and 97% to 98% of those aged 10 to 11 months and 12 to 18 months. Although proportions were small, 2% to 3% of those over 10 months did not feed themselves a rusk or similar. Of those children who had been given food other than milk, 10% of those aged 4 to 6 months could feed themselves with a spoon. This increased to 19% of those aged 7 to 9 months, 29% of those 10 to 11 months and 69% of those children aged 12 to 18 months. There was therefore variation in the proportions of children feeding themselves; this may be due to the abilities of the children, but may also be due to the age at which parents first tried the various ways of eating with their children.

Tables 5.4.1 to 5.4.7

5.5. Breast milk and fluid intake

5.5.1. Introduction

Two protocols were followed for the stable isotope component of the clinic visit. Protocol 1 (breastfed protocol) was intended for children who were breastfed to any degree, at the time of the clinic visit. This was used to provide values for breast milk intake, in grams per day[7]. A breast milk diary was also completed as part of the protocol. Protocol 2 (non-breastfed protocol) was intended for children who were not breastfed at the time of the clinic visit or who were breastfed and found the breastfeeding protocol too burdensome to complete, since it required a much longer urine collection period. See Chapter 2 and Appendices A and J for details of the methodology.

5.5.2. Adherence to stable isotope protocols 1 and 2

Subjects were excluded either before or after analysis for the following reasons:

- Drinking less than 50% of the tracer water dose.
- Collecting fewer than three post-dose samples.
- Not recording dates and times of sample collection.
- Not collecting a pre-dose sample.
- The child only consuming small amounts of breast milk from the mother, therefore receiving only a small amount of the stable isotope from the mother (breastfed protocol only).

A second round of exclusions, using the same criteria as above, was carried out once the isotope results had been scrutinized. At this stage comparison of the data obtained with a general model of isotope appearance and elimination from the participants allowed further checks on the adequacy of dosing and recording.

5.5.2.1. Protocol 1

Of the 104 mother-baby pairs who took part in the breastfed protocol, urine samples were returned for 103 cases. Valid stable isotope results for breast milk intake were obtained for 90 mother-baby pairs (86%). Of the 13 (14%) invalid stable isotope results, one was excluded on the basis of inadequate recording of sample collection times, and the remaining 12 were excluded due to very small amounts of breast milk being received by the child such that the value determined was less than experimental error.

Breast milk diaries were returned for 99 out of the 104 mother-baby pairs. For the 90 valid stable isotope results, 88 had completed breast milk diaries.

5.5.2.2 Protocol 2

Of the 740 children who took part in the non-breastfed protocol, urine samples were returned for 712 children. Valid stable isotope results were obtained for 532 (75%). Of the 180 (25%) invalid stable isotope results, 131 were excluded before analysis and 49 were excluded after analysis for the above reasons.

5.5.3. Breast milk intakes estimated from the breast milk diary (g/day)[8]

For children aged 6 to 9 months, mean daily breast milk intake estimated from the breast milk diary was 450g which equated to 300kcal of energy. Children aged 10 to 11 months were estimated to consume 380g of breast milk (250kcal of energy) and children aged 12 months and over were estimated to consume 430g of breast milk (290kcal of energy).

Table 5.5.1

5.5.4 Breast milk intakes obtained from stable isotope assessment (g/day) using dose-to-mother method[8,8]

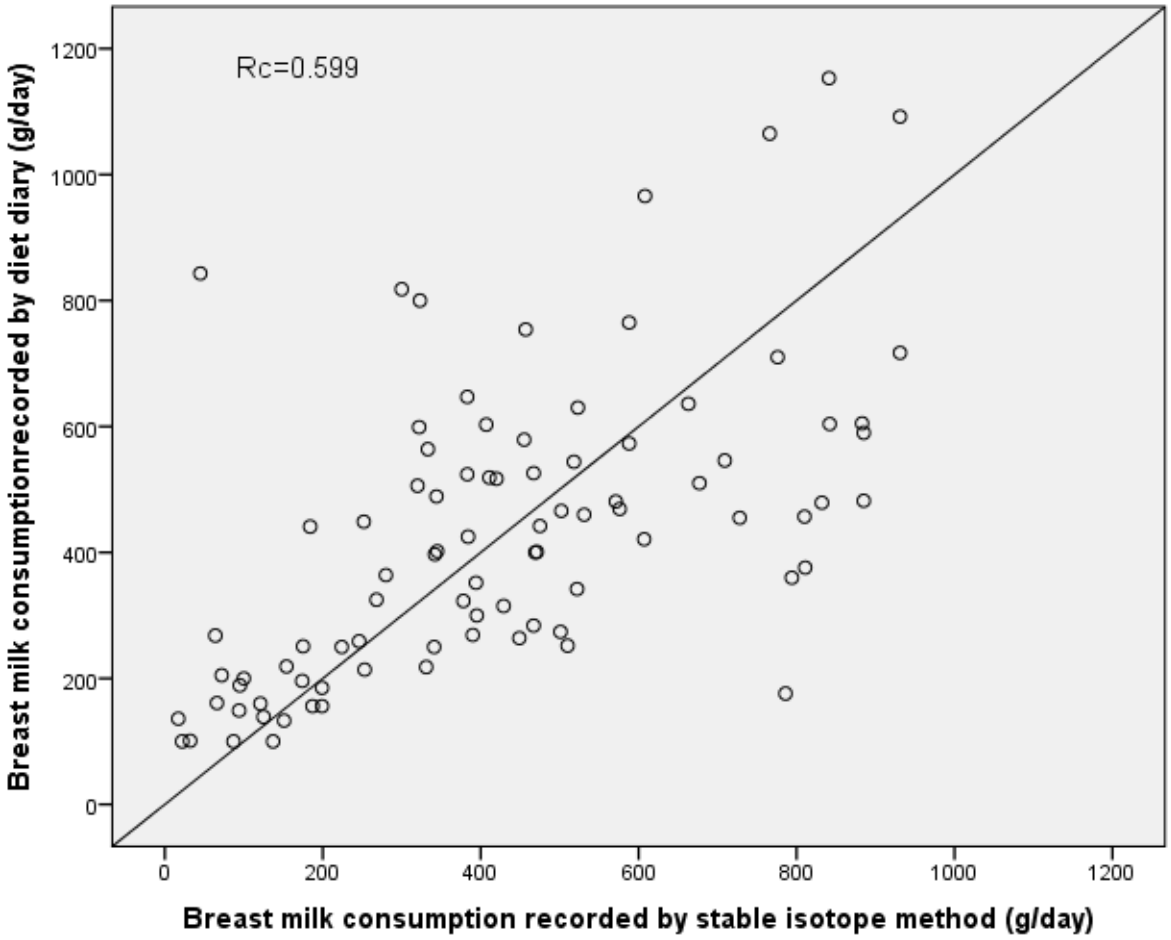
For children aged 6 to 9 months, mean daily breast milk intake estimated by the dose-to-mother method was 470g which equated to 320 kcal of energy and was on average 51% of the total fluid intake. Children aged 10 to 11 months was estimated to consume 350g of breast milk (230kcal of energy) which was 39% of their total fluid intake and children aged 12 months and over were estimated to consume 400g of breast milk (270kcal of energy) which was 38% of their total fluid intake.

Table 5.5.2

5.5.5. Comparison between stable isotope and diary approaches for breast milk consumption

For those children for whom there was both a breast milk diary and a stable isotope result, a comparison of the methods for estimating breast milk consumption was undertaken. The purpose of this comparison was to determine whether the subjective breastfeeding diary method is reliable when compared against the objective stable isotope method. Figure 5.A shows a concordance correlation to assess agreement between the two methods. The correlation coefficient evaluates the degree to which the relationship between the measurements is represented by a line through the origin at an angle of 45 degrees. Complete agreement between the two methods would have resulted in all the data points lying along the line. As Figure 5.A demonstrates there is some deviation from the line, which is as expected due to the experimental and human error associated with the two methods. However, the agreement between the two methods of measuring breast milk consumption is considered 'moderate'[9] (Rc = 0.599) and the diary method is considered a reliable method for estimating volume of breast milk consumed. This is a useful finding for further studies.

Figure 5.A. Agreement between measures of breast milk intake



5.5.6. Fluid intake

Absolute fluid intake is derived from the product of the total body water pool and the fraction of it which is excreted per day (under conditions of fluid balance water intake and water losses are equal). Although the stable isotope method provides accurate and precise estimates of the fractional rate at which the body water is turned over (i.e. excreted and replaced) the difficulties experienced in accurately estimating stable isotope losses due to spillage, dribbling and posseting prevented determination of the size of the body water and therefore calculation of absolute fluid intake at this time. Results for fluid intake are therefore not presented in this report. Data for water turnover and water flux are presented in Appendix J.

References and endnotes

[1] The Infant Feeding Survey (IFS) is a longitudinal postal survey carried out every five years, which collects information on infant feeding practices across the UK for infants aged 4 weeks to 10 months. Available online: http://www.ic.nhs.uk/searchcatalogue?productid=9569&q=infant+feeding+survey&sort=Relevance&size=10&page=1#top

[2] A question was asked in DNSIYC to obtain data on frequency of exclusive breastfeeding. However, it is clear from the responses that some of those interviewed misunderstood the question and hence no results are available on the frequency of exclusive breastfeeding at the time of the survey from the CAPI data. The diet diary provides reliable results on the number of children being exclusively breastfed at the time of the survey.

[3] The key recommendations for making and storing powdered infant formula are:

- Feeds should be made up with boiled water that has been allowed to cool to no less than 70°C. Thus the feed should be made within 30 minutes after the water has boiled.
- When making the feed the boiled water should be added to the bottle first, followed by the correct amount of powdered formula.
- Once the feed is prepared it should be cooled as quickly as possible to feeding temperature.
- Ideally, powdered formula should be made up fresh for each feed rather than being stored. Although not ideal, feeds can be made up and stored below 5°C for a maximum of 24 hours.
- If mothers need to feed their infant when away from home they should make up fresh feeds as they need them following the recommendations above.
- It is suggested that mothers may consider carrying a flask of just boiled water with them when away from the home. Alternatively, mothers could use a liquid ready-to-feed formula when away from home

NHS Guide to Bottle Feeding 2011. Available online: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_124526.pdf

[4] Department of Health. 2003. Infant Feeding Recommendation. Available online: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4096999.pdf

[5] http://www.ic.nhs.uk/pubs/ifs2005

[6] Department of Health. 1994. Weaning and the weaning diet. Report on health and social subjects, 45. HMSO, London.

[7] It was assumed that 1ml = 1g of breast milk = 0.67kcals. Values have been rounded to the nearest 10g and 10kcals.

[8] http://www-pub.iaea.org/MTCD/publications/PubDetails.asp?pubId=8168

[9] Lin L.I. (1989). A concordance correlation coefficient to evaluate reproducibility. Biometrics, 45, 255-268.

Chapter 6 Food consumption and nutrient intake

Summary of findings

- Children in the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) consumed a variety of foods and dietary recommendations were generally met by the majority of the survey population. Mis-reporting of food consumption is known to be a problem in dietary surveys, which may affect the reliability of all estimates of nutrient intake.

- Twenty nine per cent of children aged 4 to 6 months in DNSIYC consumed breast milk during the four-day food diary period, decreasing gradually to 8% of those aged 12 to 18 months. Two children, both in the 4 to 6 month age group, were exclusively breastfed at the time of the survey.

- Fifteen per cent of children aged 4 to 6 months consumed whole cow's milk over the survey period with a mean consumption of 53g per day among consumers. This increased to 79% of those aged 12 to 18 months with a mean consumption of 329g per day.

- The mean fruit and vegetable consumption, including contribution from mixed dishes, for the whole population ranged from 100g per day for children aged 4 to 6 months to 170g per day for those aged 12 to 18 months.

- Commercial infant foods (meat, fish, fruit, dairy or cereal based) were consumed by a greater proportion of children aged 4 to 11 months compared to children aged 12 to 18 months. These foods contributed 13% to 17% of daily energy intake for children aged 4 to 11 months, compared to 6% in children aged 12 to 18 months.

- Over the four-day food diary period, the proportion of children given a supplement ranged from 5% for those aged 4 to 6 months to 10% for those aged 12 to 18 months. Multi-vitamins were most commonly given.

- Seventy five per cent of boys and 76% of girls exceeded the Estimated Average Requirement (EAR) for energy.

- Mean protein intakes were well above the RNI in all age groups.

- Mean daily intakes of all vitamins and minerals from all sources (including supplements), were above or close to the Reference Nutrient Intake (RNI) for all age groups with the exception of vitamin D for non-breastfed children aged 12 to 18 months and for breastfed children (by any degree of breastfeeding) across all age groups. It should be noted that these are underestimates as they do not include the contribution of breast milk to vitamin D intake.

- The proportion of children with daily intakes of vitamins and minerals from all sources below the Lower Reference Nutrient intake (LRNI) was low (8% or less) except for iron for all age groups (10% to 14%) and magnesium for children aged 4 to 6 months (10%).

- Mean daily intakes of sodium were 85% of the RNI for children aged 4 to 6 months, but increased to 181% for children aged 12 to 18 months, which equates to an intake of 2.3g salt per day, exceeding the recommendation for this age group.

6.1. Introduction

The results presented in this chapter derive from the dietary assessment using the four-day food diary and represent a daily average of the days assessed. The survey was designed to start on random days, such that all days of the week would be equally represented. If the allocated day was inconvenient for parents of participants they were asked to start the following day and if this was not possible, then the next convenient day. This was to offer flexibility in order to maintain high response rates. As shown in Table 6.A, there was a greater proportion of Fridays, Saturdays and Sundays in the completed diary days for the Diet and Nutrition Survey of Infants and Young Children (DNSIYC), suggesting that there was a preference to complete diaries at the weekend. In this age group, the type and quantity of foods eaten would not be expected to differ between week days and weekend days and hence the greater proportion of weekend days was not considered to have created bias in the data.

Table 6.A. Percentage of records by day of week

Day of Week	Days Recorded	% of total days
Monday	1479	13.9
Tuesday	1196	11.2
Wednesday	1171	11.0
Thursday	1397	13.1
Friday	1710	16.0
Saturday	1897	17.8
Sunday	1813	17.0
All	10663	100

Mis-reporting of food consumption is known to be a problem in all dietary surveys, although it is generally considered to be less of an issue for younger children than adults. It is not known to what extent it is a problem for this age group. Biased estimates of intake can result from under- or over-reporting of actual intake or intake being modified during the recording period. In this age group there may be a particular risk of under or overestimating food wastage. There is also day-to-day variation in diet, making it difficult to capture habitual diet over the short assessment period of four days. The potential for some mis-reporting needs to be borne in mind when interpreting findings from this survey. Evidence suggests that some foods and nutrients may be under- or over-reported to a greater extent than others, but there is no information available on the level to which different foods and nutrients are mis-reported in the survey.

In some sections, observational comparisons have been made between results for DNSIYC and those for the National Diet and Nutrition Survey (NDNS)[1], derived from the most recent dietary results for the rolling programme, those for Years 1 to 3[2]. Since both surveys were conducted using the same dietary assessment method (the four-day estimated food diary) and both use the same basic food composition database, it is possible to make comparisons between the two, where this is appropriate.

6.2. Foods consumed

The commentary in this section excludes non-consumers unless otherwise stated (e.g. the results for disaggregated food groups are presented for the whole population i.e. consumers and non-consumers). This is because many foods were not consumed regularly by substantial proportions of the entire population. This is a different approach to the NDNS where the main focus is on mean intakes for the entire population. No statistical testing has been carried out in Chapter 6 and therefore any differences between age groups are only observations. Intakes for breast milk have been rounded to the nearest 10g.

Tables 6.1 and 6.2 report consumption of foods and drinks as reported (referred to as non-disaggregated). However, consumption of fruit and vegetables, and meat and fish, are also reported in Table 6.3 including the contribution from composite dishes, but excluding other components of the dish such as pasta or pastry (referred to as disaggregated). The methodology for this 'disaggregation' of composite dishes is provided in Appendix D.

It should be noted that the quantity and variety of different foods consumed was expected to increase with age across the age range of children in DNSIYC due to the gradual introduction of complementary foods alongside breast milk and/or infant formula. It was also expected, therefore, that the contribution of these foods to nutrient intake would change with age.

Tables 6.1 to 6.3

6.2.1. Cereals and cereal products

Within the food group 'cereals and cereal products', the sub-food group consumed by the greatest proportion of children was 'pasta, rice, pizza and other miscellaneous cereals', ranging from 21% of children aged 4 to 6 months increasing to 83% of children aged 12 to 18 months. Mean daily consumption among consumers ranged from 30g in the youngest age group up to 46g in the eldest age group.

White bread was the major type of bread consumed in all age groups and the proportion of children consuming white bread and the amount consumed increased with age. For children aged 7 to 18 months, 20% or more consumed some brown, granary, wheatgerm or wholemeal bread during the survey period.

The proportion of children consuming breakfast cereal increased with age from 20% of the youngest age group up to 80% in the eldest age group. Mean daily consumption among consumers ranged from 13g up to 23g across the age groups.

The proportion of children consuming 'biscuits, buns, cakes, pastries and fruit pies, and puddings' increased with age. Mean consumption of puddings ranged from 25g to 37g per day among consumers across the age groups.

Tables 6.1 and 6.2

6.2.2. Milk and milk products

Results provided in this section do not include consumption of infant formula or breast milk. Whole milk was the most commonly consumed type of cow's milk for all age groups. The proportion of consumers increased with age, ranging from 15% of those aged 4 to 6 months up to 79% of those aged 12 to 18 months. Mean consumption ranged from 53g to 147g per day for consumers aged 4 to 11 months increasing to 329g per day for consumers aged 12 to 18 months. Children aged below one year of age therefore generally consumed less than a quarter of a pint (146g) of whole milk per day. This is in keeping with the recommendation that cow's milk should only be used as a main drink after the age of one year[3]. Five per cent of those aged 4 to 6 months up to 13% of those aged 12 to 18 months consumed semi-skimmed milk over the survey period.

The proportion of children consuming 'yoghurt, fromage frais and other dairy desserts' ranged from 50% of those aged 4 to 6 months, up to 86% of children aged 12 to 18 months. Mean intakes ranged from 41g to 59g among consumers across the age groups. To help visualise the portion sizes consumed, a typical child yoghurt pot weighs approximately 50g; consumers therefore had about a children's pot of yoghurt per day. The proportion of children consuming cheese increased with age from 12% of

those aged 4 to 6 months to 68% of the eldest age group; mean daily intakes among consumers ranged from 4g to 11g per day.

Tables 6.1 and 6.2

6.2.3 Eggs and egg dishes

The proportion of children consuming eggs and egg dishes increased with age from 8% of those age 4 to 6 months to 40% of those aged 12 to 18 months. The quantities eaten by consumers ranged from 10g per day for those aged 4 to 6 months to 20g per day for those aged 12 to 18 months.

Tables 6.1 and 6.2

6.2.4 Fat spreads

Mean intakes of fat spreads including butter ranged from 5g to 8g per day among consumers. Reduced fat spread was the most commonly consumed, by 13% of those aged 4 to 6 months, rising to 59% of those aged 12 to 18 months.

Tables 6.1 and 6.2

6.2.5 Meat and meat products

The proportion of infants and young children consuming commercially prepared red meat and dishes (bacon, ham, beef, veal, lamb and pork) ranged from 1% of those aged 4 to 6 months to 6% of those aged 12 to 18 months. This contrasted with homemade red meat and dishes, where the proportion of consumers increased from 16% of those aged 4 to 6 months up to 67% of those aged 12 to 18 months. Commercially prepared burgers, kebabs, sausages, meat pies and pastries were not consumed by any children aged 4 to 6 months increasing to 15% for those aged 12 to 18 months, while homemade types were consumed by 3% of those aged 4 to 6 months, rising to 35% of those aged 12 to 18 months.

Tables 6.1 and 6.2

Estimates of meat consumption from all sources including composite dishes were calculated from disaggregated data. These estimates are much lower than those shown in Table 6.1 as the disaggregated estimates do not include the non-meat components of meat dishes e.g. the pasta and cheese in meat lasagne. Using the disaggregated data, each type of meat consumed was sub-categorised as red meat which included bacon, ham, beef, lamb, pork, sausages, burgers and kebabs, or white meat, which included chicken and turkey.

Mean consumption of total meat for the whole population including non-consumers based on disaggregated data was estimated at 6g per day for children aged 4 to 6

months, up to 29g per day for those aged 12 to 18 months. This was around 50% lower across the age groups than the non-disaggregated intakes (refer to Figure 6.A). Red meat comprised 50% of total meat consumption for children aged 4 to 6 months increasing to 66% of total meat for those aged 12 to 18 months.

Table 6.3

Figure 6.A. Non-disaggregated and disaggregated meat (mean in grams) consumption for the entire population including non-consumers.

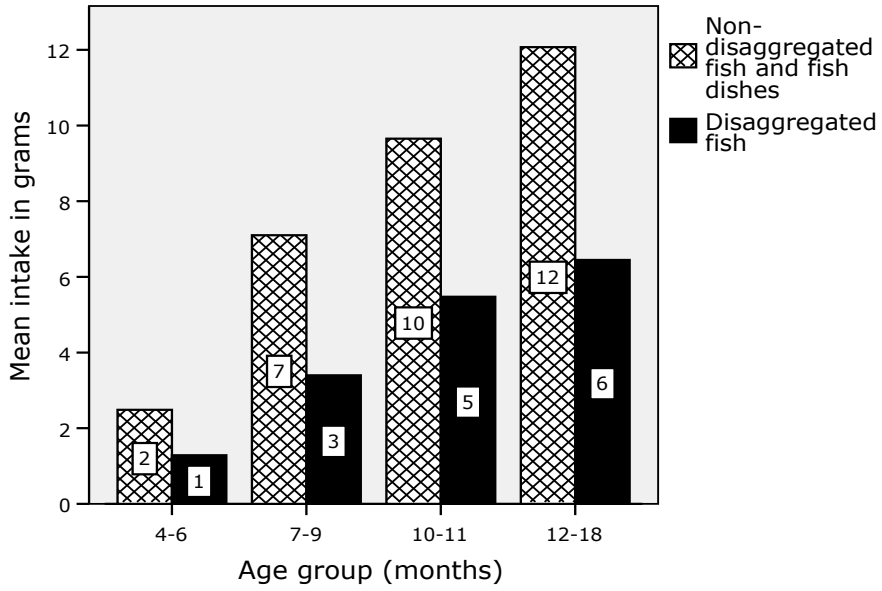
6.2.6 Fish and fish dishes

The proportion of infants and young children consuming fish and fish products increased with age from 13% of those aged 4 to 6 months to 53% of those aged 12 to 18 months. Mean daily intakes ranged from 19g for children aged 4 to 6 months to 23g for those aged 12 to 18 months for consumers.

After disaggregation of composite dishes, mean consumption of fish from all sources for the entire population including non-consumers ranged from 1g per day for children aged 4 to 6 months to 6g per day for those aged 12 to 18 months. When disaggregated to exclude non-fish components, fish consumption was around 50% lower across the age groups than the non-disaggregated intakes (refer to Figure 6.B). These differences from non-disaggregated figures were similar to those seen for meat.

Tables 6.1 to 6.3

Figure 6.B. Non-disaggregated and disaggregated fish (mean in grams) consumption for the entire population including non-consumers.



6.2.7 Vegetables and fruit

Tables 6.1 and 6.2 provide results for fruit and vegetable consumption excluding the contribution from composite dishes. This section describes consumption of fruit and vegetables including the contribution from composite dishes.

Table 6.3 shows the mean consumption of vegetables for the entire population including non-consumers based on disaggregated data, ranging from 52g per day for children aged 4 to 6 months up to 74g per day for those aged 12 to 18 months. Mean fruit consumption after disaggregation ranged from 48g per day for children aged 4 to 6 months, up to 96g per day for those aged 12 to 18 months. These figures are considerably higher than those shown in Table 6.1 as the latter are based on fruit, salad and cooked vegetables consumed and reported as discrete items, and exclude fruit and vegetables in mixed dishes that are reported according to the main component of the dish. Taking vegetables from composite dishes into account, i.e. after disaggregation, vegetable consumption was over 100% higher for those aged 4 to 6 months, 7 to 9 months and 10 to 11 months and 68% higher for those aged 12 to 18 months than the non-disaggregated totals (refer to Figure 6.C). Fruit consumption after disaggregation was 92% higher for those aged 4 to 6 months, and 26% higher for those aged 12 to 18 months (refer to Figure 6.D). The differences between estimates for non-disaggregated and disaggregated consumption are much greater than for older age groups as seen in NDNS (such as adults aged 19-64 years), probably due to the high number of commercial infant foods containing fruit or vegetables which are not included in the non-disaggregated vegetable and fruit totals.

Tables 6.1 to 6.3

Figure 6.C. Non-disaggregated and disaggregated vegetable (mean in grams) consumption for the entire population including non-consumers.

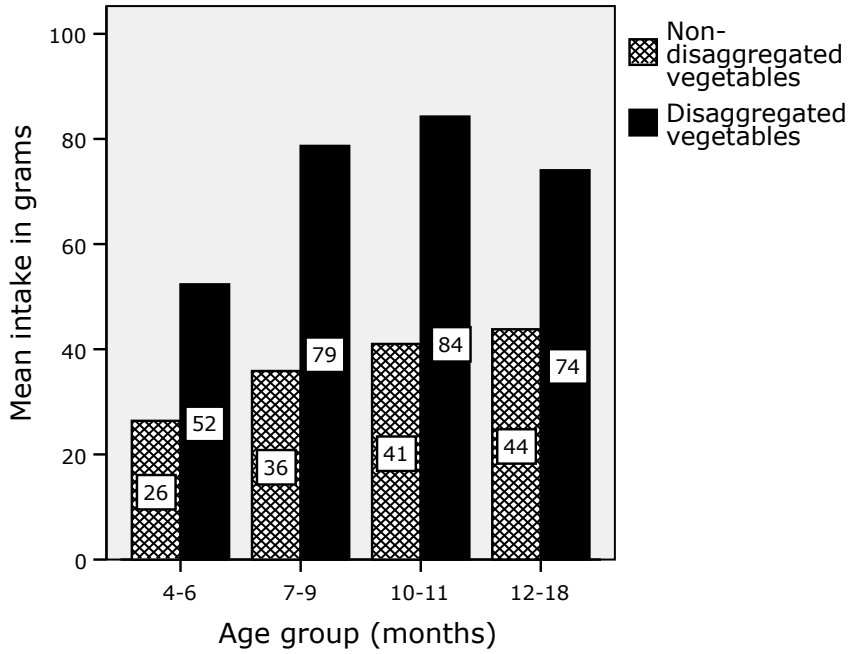
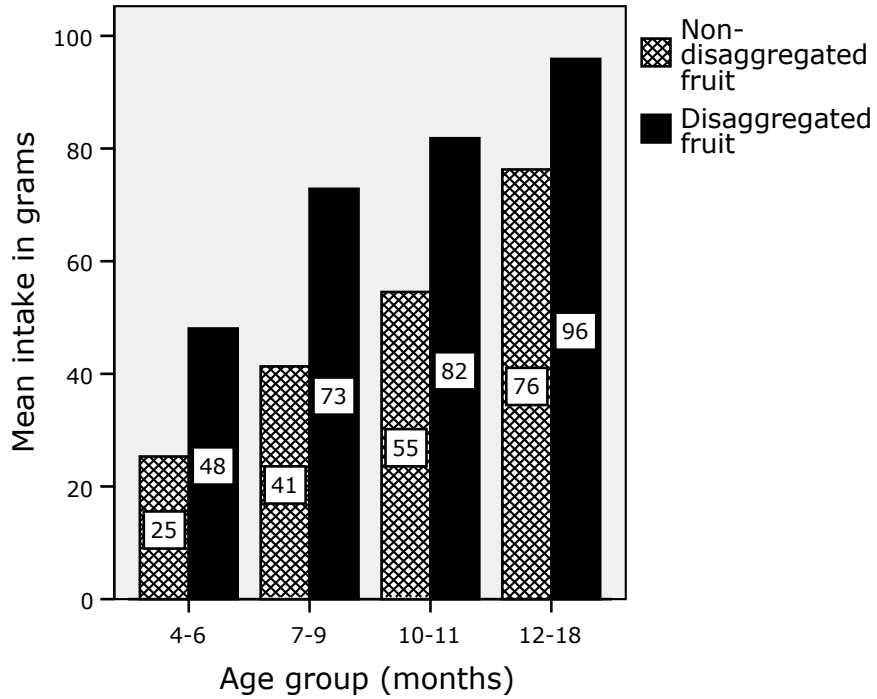


Figure 6.D. Non-disaggregated and disaggregated fruit (mean in grams) consumption for the entire population including non-consumers.



Mean consumption of total fruit and vegetable (excluding fruit juice) ranged from 100g per day for children aged 4 to 6 months, to 170g per day for those aged 12 to

18 months. These quantities are relatively high. For example, mean total fruit and vegetable consumption by those aged 12 to 18 months was similar to the mean consumption of total fruit and vegetables after disaggregation by those aged 11 to 18 years in NDNS (177g). Mean fruit consumption of children aged 7 to 18 months in DNSIYC (73g to 96g) was higher than the 11 to 18 year age group in NDNS (62g). There is currently no recommendation for the number of portions of fruit and vegetables consumed per day or the recommended portion size for this age group. To put it into context, adults are advised to consume five 80g portions of fruit and vegetables per day (400g), so children in DNSIYC consumed about one to two adult portions a day, which is relatively high given their body size at this age.

6.2.8 Savoury snacks, sugar and confectionery

Mean consumption of savoury snacks was below 6g per day for consumers in all groups although the proportions of children consuming these foods increased with age from 7% of those aged 4 to 6 months to 43% of those aged 12 to 18 months. Hence, although they ate small amounts, substantial proportions of older children were given these in the four-day food diary period.

Mean consumption of 'sugar, preserves and confectionery' ranged from 3g to 8g per day by consumers. However, like savoury snacks, the proportion having these foods increased with age, such that 62% of those aged 12 to 18 months were consuming these foods.

Tables 6.1 and 6.2

6.2.9 Beverages

The proportion of children consuming water ranged from 62% of those aged 4 to 6 months to 76% or more for those aged 7 to 18 months. Mean daily consumption ranged from 63g for consumers aged 4 to 6 months to 143g for those aged 12 to 18 months.

Fruit juice was consumed by 8% of children aged 4 to 6 months rising to 26% for those aged 12 to 18 months, with mean daily intakes for consumers ranging from 11g for consumers aged 4 to 6 months to 50g for consumers aged 12 to 18 months. To help visualise the quantities consumed, an individual carton of fruit juice typically contains 200g of juice, so children in DNSIYC were typically consuming between a third of a carton to one and three quarter cartons of fruit juice per week.

The proportion of children consuming soft drinks (not low calorie) was very similar to those consuming juice, ranging from 6% to 26% across the age groups. The quantities consumed were however greater, with a mean daily consumption of 43g for consumers aged 4 to 6 months, increasing to 158g for those aged 12 to 18 months.

Somewhat higher proportions drank low calorie than non-low calorie soft drinks, particularly in the older age groups, with 46% of children aged 12 to 18 months consuming low calorie soft drinks compared to 26% consuming non-low calorie. Quantities were also higher for low calorie soft drinks; mean consumption ranged from 57g per day for consumers aged 4 to 6 months to 189g per day for consumers aged 12 to 18 months.

Tables 6.1 and 6.2

6.2.10 Breast milk and infant formula

Breast milk is the best form of nutrition for infants and exclusive breastfeeding is recommended for around the first six months (26 weeks) of an infant's life[4,5]. Infant formula is the only substitute for breast milk and although there are a variety of types available on the market, unless advised by a health professional, 'first milk' is the only type of formula an infant requires until the age of 12 months when cow's milk can be introduced as a main drink into the diet. There are therefore no requirements for infants to consume other types of formula including: 'hungrier babies milk' (also known as 'second milk'); follow-on formula; 'goodnight milk'; or 'growing up milk'. Follow-on formula and 'goodnight milk' are not recommended before six months and 'growing up milk' is not designed for children aged under 12 months. Complementary foods should be introduced around six months and breastfeeding (and/or infant formula, if used) should continue beyond this time alongside appropriate types and amounts of complementary foods[6].

Twenty nine per cent of children aged 4 to 6 months consumed breast milk in the four-day food diary period, 23% of those aged 7 to 9 months, 15% of those aged 10 to 11 months and 8% of those aged 12 to 18 months.

Mean breast milk consumption estimated from recorded feeding time and volumes (if expressed) for consumers decreased with age from 670g per day for those aged 4 to 6 months to 290g per day for those aged 12 to 18 months. Overall, there were only two children being exclusively breastfed in DNSIYC, both in the 4 to 6 month age group.

Thirty seven per cent of children aged 4 to 6 months consumed 'first milk', decreasing to only 1% of those aged 12 to 18 months. Similarly 20% of those aged 4 to 6 months consumed 'hungrier babies milk', again decreasing to only 1% of those aged 12 to 18 months. Thirty two per cent of those aged 4 to 6 months consumed follow-on milk (which is not recommended before six months), rising to 56% of those aged 7 to 9 months, and 59% of those aged 10 to 11 months, but decreasing to 16% of those aged 12 to 18 months. There was little consumption of 'growing up milk', none up to age nine months, 3% of those aged 10 to 11 months and 18% of those aged 12 to 18 months. Very small proportions of children (0% to 6%) consumed soy or other infant specific milks.

The 32% of infants aged 4 to 6 months consuming follow-on formula may include some infants aged four or five months, i.e. younger than six months, not observing the infant formula recommendation.

Tables 6.1 and 6.2

6.2.11 Commercial infant foods

Commercial infant foods were consumed mainly by children under the age of 12 months, with those aged 12 to 18 months more commonly consuming non-infant specific foods. Over 50% of children aged 4 to 11 months consumed infant meat and fish based products and dishes during the four-day food diary period, decreasing to 29% of those aged 12 to 18 months. Other savoury based foods and dishes, fruit based foods and dishes, dairy based foods and dishes, and cereal based foods and dishes also showed a similar pattern of consumption. The only type of commercial infant foods for which there was an increase with age was for snacks (sweet and savoury) where 34% of children aged 4 to 6 months consumed these, rising to 60% or over for those aged 7 to 11 months then falling to 42% of those aged 12 to 18 months. Mean consumption of infant specific snacks (sweet and savoury) ranged between 6g to 7g per day among consumers.

Tables 6.1 and 6.2

6.3. Supplements

Information on consumption of dietary supplements was collected both in the four-day food diary and in the Computer Assisted Personal Interview (CAPI), which asks about consumption in the year before interview. Dietary supplements were defined for parents as products intended to provide additional nutrients or give health benefits and taken in liquid, powder, tablet or capsule form. In the diary parents wrote down the details of any supplements they gave to their children on each diary recording day. In the CAPI, parents were asked to list any dietary supplements given to their children over the past year.

Five per cent of children aged 4 to 6 months, 7% of those aged 7 to 9 months, 8% of those aged 10 to 11 months and 10% of those aged 12 to 18 months were given at least one supplement during the four-day food diary recording period. The main supplement given to children during the four-day food diary was a multi-vitamin supplement. A higher proportion of parents reported having given at least one supplement to their children during the previous year than had done so in the four-day food diary period. Six per cent of children aged 4 to 6 months, 14% of those aged 7 to 9 months, 13% of children aged 10 to 11 months and 20% of those aged 12 to 18 months had been given a supplement in the past year. The main supplement given to children in the past year was a multi-vitamin supplement.

Tables 6.4 and 6.5

6.4. Nutrient Intakes

This section presents daily intakes of energy, macronutrients (protein, fat, carbohydrate, sugars and non-starch polysaccharides) and micronutrients (vitamins and minerals) for the entire population estimated from the food consumption data, including from the consumption of supplements. It also shows the percentage contribution of the major food types to intake of each nutrient for the entire population, including non-consumers. This analysis has been carried out using the food groups generally used in Department of Health (DH) dietary surveys and not disaggregated food groups.

Dietary Reference Values (DRVs) for food energy and nutrients provide a best estimate of the requirements of the UK population and its sub-groups, and present criteria against which to judge the adequacy of their intake[7]. These DRVs apply to groups of people in health and are not appropriate for the definition of requirements for individuals. The DRV for food energy is defined as the Estimated Average Requirement (EAR), that is, the average energy requirement for any population group. During infancy and childhood, the energy requirement has to meet the needs for healthy growth and development.

In this report, average daily intakes of total energy[8] for boys and girls were compared to age and sex specific UK reference values taken from the Scientific Advisory Committee on Nutrition (SACN) energy report[9] by calculating the EAR for each child in DNSIYC based on their body weight. For children under 12 months figures were used for mixed or unknown feeding i.e. it was assumed the proportions of breast milk and formula milk substitute used were not known. The median physical activity level (PAL)[10] value adjusted for growth was used for children aged over 12 months. Macronutrients and micronutrients for children were compared to the 1991 COMA report on Dietary Reference Values for Food Energy and Nutrients for the United Kingdom[7]. The only macronutrient, other than energy, for which DRVs are set for this age group is protein.

Where the UK Reference Nutrient Intakes (RNIs) and Lower Reference Nutrient Intakes (LRNIs) have been published for this age group[7], mean intakes as a proportion of the RNI and the proportion with intakes below the LRNI are given. The RNI for a vitamin or mineral is the amount of the nutrient that is sufficient for about 97.5% of people in the population. If the average intake of a sample is at the RNI, then the risk of deficiency in the sample is judged to be very small. The inadequacy of vitamin or mineral intake can be expressed as the proportion of individuals with intakes below the LRNI. The LRNI for a vitamin or mineral is set at the level of intake considered likely to be sufficient to meet the needs of only 2.5% of the population. However, it should be noted that DRVs for some micronutrients such as magnesium, potassium, selenium and zinc are based on very limited data so caution should be used when assessing adequacy of intake using the LRNI.

Intakes of vitamins and minerals are reported in two ways: 1) intakes from all sources, that is, including supplements as recorded in the four-day food diary; and 2) for recommended vitamins (A, C and D), intakes from food sources only. The proportion of children taking supplements was small, as reported in section 6.3. The percentage contribution of the major food types to selected vitamins and minerals are shown in Tables 6.25 to 6.27 and 6.32 to 6.35.

Other than energy, DRVs have not been set for exclusively breastfed infants as breast milk is recommended to provide the best nutrition for infants. DRVs are set only for infants whose nutrient intakes are dependent on the composition of breast milk substitutes (i.e. infant formula) being offered. The vitamin D content of breast milk is not known (see Annexe D). In DNSIYC the contribution of breast milk to vitamin D intakes for breastfed infants has therefore been excluded, however this provides an underestimation of vitamin D intake for breastfed infants[11].

The commentary in this section refers to mean intakes for the total population. Wherever they exist, the DRVs (that is the EARs, RNIs and LRNIs) are provided in tables.

6.4.1 Energy

The mean daily intake of total energy[8] for children aged 4 to 6 months was 2.93 MJ (696 kcal), 3.31 MJ (788 kcal) for children aged 7 to 9 months, 3.61 MJ (859 kcal) for children aged 10 to 11 months and 4.07 MJ (967 kcal) for children aged 12 to 18 months.

The percentage of children calculated as exceeding the age and sex specific EAR for energy[10] (calculated for the individual based on body weight) was similar for boys and girls, at 75% and 76% respectively. The percentage of boys and girls exceeding the EAR increased with age, from between 52% and 59% for those aged 4 to 6 months, up to 88% of those aged 12 to 18 months, providing evidence that energy intakes increase with age following the introduction of complementary foods. It should be noted that 50% of the population are expected to have requirements exceeding the EAR.

Infant formula was the main source of energy for children aged 4 to 11 months while for children aged 12 to 18 months, the food group 'milk and milk products' was the main source of energy (27%) followed by the food group 'cereals and cereal products' (24%).

In general, infant formula, breast milk and the food group 'commercial infant foods' contributed decreasing proportions of energy with age. For example, the contribution of infant formula decreased from 51% for children aged 4 to 6 months to 10% for children aged 12 to 18 months. Breast milk consumption followed a similar pattern contributing 18% for children aged 4 to 6 months down to 2% for children aged 12 to

18 months and 'commercial infant foods' contributing 16% for children aged 4 to 6 months decreasing to 6% for those aged 12 to 18 months. In contrast, the contribution of non-infant specific foods increased with age. For example, the food group 'cereals and cereal products' increased from 3% for children aged 4 to 6 months to 24% for those aged 12 to 18 months.

Tables 6.6 to 6.8

6.4.2. Protein

Mean protein intakes were well above the RNI in all age groups (the RNI for protein ranges from 12.7g to 14.5g per day for the DNSIYC age range)[7]. Protein provided 10% of total energy for children aged 4 to 6 months increasing to 16% for children aged 12 to 18 months.

For children aged 4 to 11 months, infant formula was the largest contributor to protein intake, providing an average of 44% of intake for children aged 4 to 6 months, 28% for children aged 7 to 9 months and 21% for children aged 10 to 11 months; the food group 'commercial infant foods' was the second largest contributor for those aged 4 to 6 months and 7 to 9 months (19% and 20% respectively), while for those aged 10 to 11 months, the food group 'milk and milk products' was the second largest at 18%. For children aged 12 to 18 months, the food group 'milk and milk products' was the largest contributor to protein intake providing 35%. The food groups 'cereals and cereal products' and 'meat and meat products and dishes' provided 18% and 17% of protein intake respectively for children aged 12 to 18 months.

In general, the contribution of the food group 'meat and meat products and dishes' to protein intake increased with age, from 4% for children aged 4 to 6 months to 17% for those aged 12 to 18 months. A similar pattern was seen for the intake of the food group 'cereals and cereal products' and the food group 'milk and milk products', rising from 3% to 18% and 8% to 35% respectively for children aged 4 to 6 months to children aged 12 to 18 months. This is as expected as the variety of complementary foods introduced increases with age.

Tables 6.6 and 6.9

6.4.3. Total fat

It should be noted that the maximum dietary recommendations regarding the proportion of energy intake as fat for the general population do not apply for children aged under 5 years. This is due to the importance of dietary fat in achieving energy requirements for this age group while consuming a manageable volume of food.

Total fat provided 41% of total energy for children aged 4 to 6 months, 36% for those aged 7 to 9 months and 35% for children aged 10 to 18 months.

The major contributor to total fat intake for children aged 4 to 11 months was infant formula, with the contribution highest in children aged 4 to 6 months at 60%, with a contribution of 49% for children aged 7 to 9 months and 40% for children aged 10 to 11 months. For children aged 4 to 9 months, the second largest contributor to total fat intake was breast milk, providing an average of 21% and 11% of intake for children aged 4 to 6 months and 7 to 9 months respectively. For children aged 10 to 11 months, the second largest contributor was the food group 'milk and milk products' (16%). For children aged 12 to 18 months, the main contributor was the food group 'milk and milk products' (37%) followed by the food group 'cereals and cereal products' and infant formula, both at 12% of protein intake.

Tables 6.6 and 6.10

6.4.3.1. Saturated fatty acids

Saturated fatty acids provided 15% to 18% of total energy across all age groups with the contribution decreasing with age.

The main source of saturated fatty acids for children aged 4 to 11 months was infant formula, providing an average of 60% of saturated fat intake for children aged 4 to 6 months, 50% for 7 to 9 months and 40% for 10 to 11 months. The second largest contributors were breast milk (22%) for children aged 4 to 6 months, the food group 'milk and milk products' (13%) and breast milk (12%) for children aged 7 to 9 months, and 'milk and milk products' (22%) for children aged 10 to 11 months. For children aged 12 to 18 months, 'milk and milk products' (48%), particularly whole milk (32%), was the main source of saturated fatty acids with infant formula and the food group 'cereals and cereal products' the second largest contributors (both 11%).

Tables 6.6 and 6.11

6.4.3.2. Trans fatty acids

Trans fatty acids are derived from two sources in the diet: those that occur naturally in meat and dairy products of ruminant animals, and those produced artificially through food processing. Trans fatty acids provided 0.5% or less of total energy across all age groups. The main sources of trans fatty acids were natural sources, as the food group 'milk and milk products' was the largest contributor for all children aged seven months or over (36% to 56%) and was the second largest contributor for children aged 4 to 6 months (27%); particularly consumed in 'yoghurt, fromage frais and other dairy desserts' (19%) for children aged 4 to 6 months and 17% for children aged 7 to 9 months and whole milk (29%) for children aged 12 to 18 months. The contributions to trans fatty acid intake from other sources, such as the food group 'commercial infant foods' (4% to 37%), fat spreads (3% to 8%) and the food group 'cereals and cereal products' (4% to 9%) were smaller across all age groups.

Tables 6.6 and 6.12

6.4.4. Carbohydrate

Total carbohydrate provided 50% of total energy intake for children aged 4 to 6 months, 52% for children aged 7 to 9 months, 51% for children aged 10 to 11 months and 49% for children aged 12 to 18 months.

The major contributor to carbohydrate intake for children aged 4 to 11 months was infant formula (46% for those aged 4 to 6 months, 35% for those aged 7 to 9 months, and 28% for those aged 10 to 11 months). The second largest contributor to carbohydrate intake for children aged 4 to 9 months was the food group 'commercial infant foods' (20% to 21%), while for children aged 10 to 11 months, it was the food group 'cereals and cereal products' (21%). For children aged 12 to 18 months the major contributor to carbohydrate intake was 'cereals and cereal products' (34%) followed by the food group 'milk and milk products' (18%, with whole milk providing 10%).

Overall, the contribution from infant formula, breast milk and 'commercial infant foods' to carbohydrate intake decreased with age, as expected, from 82% for children aged 4 to 6 months to 18% for children aged 12 to 18 months.

Tables 6.6 and 6.13

6.4.4.1. Total sugars

Sugars provided 38% of total energy for children aged 4 to 6 months, 33% for those aged 7 to 9 months, 29% for those aged 10 to 11 months and 26% for children aged 12 to 18 months.

The main contributor to total sugars intake for children aged 4 to 11 months was infant formula (54%, 45% and 40% for children aged 4 to 6 months, 7 to 9 months and 10 to 11 months respectively). The second largest contributor was breast milk (19%) for children aged 4 to 6 months, the food group 'commercial infant foods' (15%) for those aged 7 to 9 months, and the food group 'milk and milk products' (15%) for those aged 10 to 11 months. For children aged 12 to 18 months, 'milk and milk products' was the main source of total sugars (33%) followed by fruit (19%). The contribution of milk to total sugars is mainly due to the presence of milk sugars, especially lactose.

Tables 6.6 and 6.14

6.4.4.2. Non-milk extrinsic sugars (NMES)

Non-milk extrinsic sugars (NMES) intake increased with age, providing an average of between 4% of total energy for children aged 4 to 6 months and 8% for children aged 12 to 18 months.

The main contributor to NMES for children aged 4 to 6 months and 7 to 9 months was the food group 'commercial infant foods' (44% and 34% respectively), particularly 'fruit based foods and dishes' and 'cereal based foods and dishes'. For children aged 10 to 18 months, the main contributor to NMES was the food group 'milk and milk products'; 29% for children aged 10 to 11 months and 27% for children aged 12 to 18 months. Those aged 7 to 9 months also obtained 29% of NMES from this food group. This came almost entirely from 'yoghurt, fromage frais and other dairy desserts'.

Other contributors to NMES, in smaller proportions, were the food groups 'cereals and cereal products' (4% for children aged 4 to 6 months rising to 23% for children aged 12 to 18 months), 'sugars, preserves and confectionery' (2% for children aged 4 to 6 months increasing to 12% for children aged 12 to 18 months) and beverages (2% for children aged 4 to 6 months increasing to 10% for children aged 12 to 18 months). It should be noted that all the sugars in fruit juice are classified as NMES, as are half the sugars in pureed fruit. These foods, particularly pureed fruit, make a major contribution to NMES intakes in this age group.

Tables 6.6 and 6.15

6.4.4.3. Intrinsic and milk sugars (IMS)

Intrinsic and milk sugars (IMS) provided 34% of total energy for children aged 4 to 6 months, 27% for those aged 7 to 9 months, 23% for those aged 10 to 11 months and 18% for children aged 12 to 18 months.

Infant formula was the largest contributor to IMS for children aged 4 to 11 months, with 61% for children aged 4 to 6 months, 53% for those aged 7 to 9 months and 48% for those aged 10 to 11 months. The second largest contributors to IMS intake were breast milk for those aged 4 to 6 months (20%) and 7 to 9 months (12%) and fruit for those aged 10 to 11 months (15%). For the oldest age group, aged 12 to 18 months, the largest contributor to IMS intake was the food group 'milk and milk products' (37%) followed by fruit (24%).

Tables 6.6 and 6.16

6.4.4.4. Starch

Starch provided 11% of total energy for children aged 4 to 6 months, 19% for children aged 7 to 9 months, 22% for children aged 10 to 11 months and 23% for children aged 12 to 18 months.

For children aged 4 to 6 months, the main contributor to starch intake was the food group 'commercial infant foods' (51%), of which 'cereal based foods and dishes' and 'meat and fish based products and dishes' provided 22% and 13% respectively. For children aged 7 to 9 months, the main contributors to starch intake were 'commercial

infant foods' (37%) and the food group 'cereals and cereal products' (31%). For children aged 10 to 11 months and 12 to 18 months, the main source of starch was the food group 'cereals and cereal products', providing 41% and 58% respectively.

Tables 6.6 and 6.17

6.4.5. Non-starch polysaccharides (NSP)

Mean daily intakes of non-starch polysaccharides (NSP) were 4.6g for all children aged 4 to 6 months, 6.3g for those aged 7 to 9 months, 7.2g for those aged 10 to 11 months and 7.3g for those aged 12 to 18 months.

The main contributor to NSP intake for children aged 4 to 11 months was 'commercial infant foods' (ranging from 32% for the youngest group to 22% for the eldest group) and infant formula (from 31% for the youngest group to 20% for the eldest group). The food group 'cereals and cereal products' was also a major contributor for those aged 10 to 11 months (22%). For children aged 12 to 18 months the main contributors to NSP intake was 'cereals and cereal products' (34%) followed by the food group 'vegetables and potatoes' (22%). 'Vegetables and potatoes' contributed 14% to 22% to NSP intakes across the age groups and fruit contributed 9% to 14%.

Tables 6.6 and 6.18

6.4.6. Vitamins

In this section breastfeeding status is denoted by the presence or absence of breast milk in the four-day food diary. The vitamin D content of breast milk is not known (see Annexe D), therefore the results for vitamin D intake are presented in two ways: 1) for children who were not breastfed at the time that the food diary was completed; and 2) for children who were breastfed at the time of diary completion, but excluding the contribution from breast milk, this is therefore an underestimation of vitamin D intake. Hence children who were exclusively breastfed at the time of diary completion were excluded (n=2).

Mean daily intakes of vitamins from all sources (including supplements), with the exception of vitamin D, were above the RNI for all age groups. Mean intakes of vitamin D were below the RNI for non-breastfed children aged 12 to 18 months (55% of the RNI). Mean intakes of vitamin D (excluding the contribution from breast milk) were below the RNI across the age groups for children who were breastfed (by any degree of breastfeeding) ranging from 37% to 54% of the RNI, although this is an underestimation of vitamin D intake for this group. The proportion of children below the LRNI for most vitamins from all sources was very small (0% to 2%), with 8% and 5% of children aged 4 to 6 months below the LRNI for vitamin B_6 and vitamin B_{12} respectively. There is no LRNI set for vitamin D.

Table 6.19 to 6.22

There was little change in the mean intakes of vitamins A, C and D from food sources only compared to mean intakes from all sources (food sources plus supplements). For children who were breastfed, the average intake of vitamin D from food sources as a percentage of the RNI ranged from 26% to 46%, slightly lower than the percentage meeting the RNI from all sources. Dietary supplements providing vitamins A and C had no effect on the proportions of children with intakes meeting the RNI and below the LRNI.

Tables 6.23 and 6.24

As the vitamin D content of breast milk is not known the results for the per cent contribution of foods to vitamin D are presented for children who were not breastfed at the time that the food diary was completed. The major contributor to vitamin D intake from food for all age groups of children not receiving any breast milk was infant formula, providing an average of 85% of intake for children aged 4 to 6 months, 80% and 72% for those aged 7 to 9 months and 10 to 11 months respectively, and 29% for children aged 12 to 18 months. For children aged 4 to 11 months, the second largest contributor was the food group 'commercial infant foods' (9% to 12%), particularly 'cereal based foods and dishes' (5% to 7%) which are often fortified. For children aged 12 to 18 months, the second largest contributor to vitamin D intake was the food group 'milk and milk products'. It is difficult to get enough vitamin D through food alone and the main source of vitamin D is direct sunlight on the skin, although this will vary by the degree of exposure of the child's skin to summer sunshine.

Table 6.25

Infant formula was the main contributor to folate intakes for children aged 4 to 6 months, 7 to 9 months and 10 to 11 months (53%, 41% and 34% respectively) followed by the food group 'commercial infant foods' for the two younger age groups (16% and 17% respectively) and the food group 'cereals and cereal products' (16%) for those aged 10 to 11 months. For those aged 12 to 18 months, 'cereals and cereal products' (24%) and the food group 'milk and milk products' (23%) were the main sources of folate.

Infant formula was also the largest contributor to vitamin A intake for the three youngest age groups (39%, 33% and 30% respectively) followed by the food group 'commercial infant foods' (23%, 25% and 23% respectively). For children aged 12 to 18 months, the food group 'milk and milk products' was the largest contributor to vitamin A intakes (25%), followed by the food group 'vegetables and potatoes' (21%). Breast milk contributed smaller proportions, from 15% for children aged 4 to 6 months decreasing to 2% for children aged 12 to 18 months.

Tables 6.26 and 6.27

6.4.7. Minerals

Average daily intakes of minerals from all sources (including supplements) were above the RNI for most age groups[12]. Mean iron intakes were close to the RNI for children aged 7 to 9 months (94% of the RNI), 10 to 11 months (98% of the RNI) and 12 to 18 months (93% of the RNI). Children aged 4 to 6 months had mean calcium intakes close to the RNI (98% of the RNI). The proportion of children with daily intakes of minerals from all sources below the LRNI was low (5% or less) for most minerals, except for iron where 10% to 14% had intakes below the LRNI across all age groups and magnesium where10% of children aged 4 to 6 months had intakes below the LRNI.

Tables 6.28 to 6.31

Mean sodium intakes for children aged 4 to 6 months were 85% of the RNI, but increased to 181% for children aged 12 to 18 months, which equates to an intake of 2.3g salt per day. Ten per cent of children aged 4 to 6 months and 11% of those aged 7 to 9 months were below the LRNI for sodium. It should be noted that the DRVs set for sodium are based on physiological requirements for children. The RNI for sodium ranges from 280mg to 500mg per day and the LRNI ranges from 140mg to 200mg per day for children aged 4 to 18 months. DH recommends less than 400mg sodium (1g salt) per day for children aged 0 to 12 months and less than 800mg (2g salt) for children aged 1 to 3 years[13]. Mean sodium intakes for children aged 12 to 18 months therefore exceed the recommendation for this age group. The most reliable estimates of sodium intake are obtained from chemical urinary analysis as estimates derived from patterns of food consumption cannot consider salt added during food preparation.

Tables 6.28 to 6.31

The major contributor to iron intake for children aged 4 to 6 months, 7 to 9 months and 10 to 11 months was infant formula (56%, 48% and 42% respectively), followed by the food group 'commercial infant foods' (21% and 20%) for children aged 4 to 6 months and 7 to 9 months respectively, and the food group 'cereals and cereal products' (21%) for those aged 10 to 11 months. For children aged 12 to 18 months, the main contributor was 'cereals and cereal products' (41%) followed by infant formula (17%).

Table 6.32

Infant formula was the main contributor to zinc intake for children aged 4 to 6 months, 7 to 9 months and 10 to 11 months (57%, 47% and 40% respectively), followed by breast milk for those aged 4 to 6 months (17%), the food group 'commercial infant foods' for those aged 7 to 9 months (16%), and the food groups 'commercial infant foods' and 'milk and milk products for those aged 10 to 11 months

(both 13%). For children aged 12 to 18 months, the main contributor was the food group 'milk and milk products' (32%) followed by the food group 'cereals and cereal products' (18%) and infant formula (15%).

Table 6.33

The main contributor to calcium intake was infant formula for children aged 4 to 6 months, 7 to 9 months and 10 to 11 months, at 54%, 44% and 37% respectively. For children aged 12 to 18 months, the main contributor was the food group 'milk and milk products' (54%). The second largest contributor to calcium intake was breast milk (16%) for children aged 4 to 6 months, 'milk and milk products' (18% and 27% respectively) for children aged 7 to 9 months and 10 to 11 months, and the food group 'cereals and cereal products' (15%) for children aged 12 to 18 months.

Table 6.34

Infant formula (44%) was the main contributor to sodium intake for children aged 4 to 6 months followed by breast milk and the food group 'commercial infant foods' (each 16%). Infant formula was also the main contributor for those aged 7 to 9 months (25%) followed by the food group 'cereals and cereal products' (17%), which was the main contributor for children aged 10 to 11 months (24%) and children aged 12 to 18 months (29%). The second largest contributor to sodium intake for children aged 10 to 11 months was infant formula (17%), followed by the food group 'milk and milk products' (14%), which was also the second largest contributor for children aged 12 to 18 months (22%).

Table 6.35

References and endnotes

[1] The National Diet and Nutrition Survey (NDNS) is a UK survey of the food consumption, nutrient intakes and nutritional status of people aged 1.5 years and older living in private households. The NDNS is currently structured as a 'rolling programme' of continuous fieldwork. Headline results are published annually. Available online: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsStatistics/DH_128166

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[3] Department of Health. 1994. Weaning and the weaning diet. Report on health and social subjects, 45. HMSO, London.

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[6] Complementary foods/feeding: the period where infants make the gradual transition from liquid foods to eating solid and family foods.

[7] Report of Health and Social Subjects 41 *Dietary Reference Values (DRV's) for Food Energy and Nutrients for the UK.* Report on the Panel on DRV's of the Committee on Medical Aspects of Food Policy (COMA) 1991. The Stationery Office. London

[8] Total energy is equivalent to food energy as no alcohol is consumed by children of this age and is therefore named energy.

[9] Scientific Advisory Committee on Nutrition. *Dietary Recommendations for Energy*. The Stationery Office (London, 2011).

[10] For children aged under one year, energy intakes are compared with the figure for the mixed or unknown feeding group for EAR for energy. For those aged 12 to 18 months, intakes are compared to the median physical activity level (PAL) value adjusted for growth for boys and girls.

[11] A recent study, not considered in Annexe D, reported median values or the vitamin D content of human breast milk from a sample of 108 European women (two to three weeks postpartum) of 2.2µg/L (interquartile range of 1.6µg/L to 4.4µg/L) Zhang JY, Lucey AJ, Galvin K, Nolan L, Cashman KD, Higgins JR and Kiely M. Vitamin D content of human milk and associations with milk fat content and maternal serum 25-hydroxyvitamin D concentrations. *Proceedings of the Nutrition Society* (2012), 71 (OCE2), E54.

[12] The consumption of dietary supplements was small therefore the contribution of dietary supplements to mean vitamin intakes was nominal and does not differ from food sources alone, therefore mineral intakes from all sources only is presented in this section.

[13] Scientific Advisory Committee on Nutrition (SACN). *Salt and Health*. The Stationery Office (London, 2003). Available online: http://www.sacn.gov.uk/pdfs/sacn_salt_final.pdf

Chapter 7 Variations in and comparisons of dietary data

Summary of findings

- There did not appear to be any consistent variations in the diet by socio-economic category or ethnicity.

- Mean daily fruit and vegetable consumption, including composite dishes, was significantly lower in both the routine and manual and intermediate socio-economic categories compared to the managerial and professional category and significantly lower in South Asian children for both age groups and children of 'other' ethnicity compared to white children for children aged 12 to 18 months.

- Significantly more South Asian children and those of 'other' ethnicity aged 4 to 18 months were given at least one supplement during the four-day food diary recording period compared to white children.

- For children aged 4 to 11 months, mean daily intakes of non-milk extrinsic sugars (NMES) were significantly higher for those from the routine and manual category compared to those in the managerial and professional category. Mean daily intake for children aged 12 to 18 months was significantly lower for South Asian compared to white children.

- Similar to the UK sample as a whole presented by age, mean vitamin and mineral intakes were above or close to the Reference Nutrient Intake (RNI) across socio-economic categories and ethnicities with the exception of vitamin D and iron.

- For all children aged 4 to 11 months, there were no significant differences in vitamin D intake by ethnicity. White non-breastfed children aged 12 to 18 months had significantly lower vitamin D intakes compared to children of 'other' ethnicity, but were not significantly different to South Asian children.

- Relatively small proportions (<10%) had micronutrient intakes below the Lower Reference Nutrient Intake (LRNI) with the exception of iron and sodium. For those aged 12 to 18 months, the proportion with iron intakes below the LRNI was significantly greater for South Asian (28%) and 'other' (19%) children compared to white children (11%), as well as for children in the routine and manual category (17%) and intermediate category (14%) compared to the managerial and professional category (8%).

- Mean daily intakes of sodium were significantly higher in white children aged 4 to 11 months compared to South Asian children of this age and in white children aged 12 to 18 months compared to children of this age from South

Asian and 'other' ethnicities. There were no significant differences in sodium intakes for either age group by socio-economic category.

7.1. Introduction

The results presented in this chapter compare some aspects of food consumption and nutrient intake by socio-economic status and ethnicity. Socio-economic status is described according to National Statistics Socio-economic Classification (NS-SEC) categories: a. managerial and professional b. intermediate (e.g. clerical and administrative occupations, sales and service occupations, technical and auxiliary occupations and engineering occupations) c. routine and manual and d. non-classifiable (for those not able to be categorised as one of the other three categories and therefore could include individuals within all three of the other categories). Ethnicity is described in three groups: white, South Asian and 'other'. Because of the small numbers of each age in each ethnic or socio-economic group, results have been consolidated into two age groups, 4 to 11 months and 12 to 18 months.

The numbers in each NS-SEC category indicate that much higher proportions of children were in either the managerial and professional category or the routine and manual category than the intermediate and non-classifiable categories for both those aged 4 to 11 months and those aged 12 to 18 months. The non-classifiable category had the smallest proportion of children (7% for both age groups) and this should be borne in mind when examining the results. The numbers in each NS-SEC category and ethnicity of the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) sample were generally representative of the UK population (see sections 3.3.4 and 3.3.6). The majority of children in DNSIYC were white (at least 80% for both age groups), with much smaller proportions of South Asian and 'other' children.

Tables 7.1a and 7.1b

Results for foods have been limited to fruit and vegetables and meat and fish consumption after disaggregation, and refer to mean values for the total population, including non-consumers. Nutrient intakes have been limited to key macronutrients and micronutrients of policy interest and are described from all sources, including supplements. Contributors to key nutrients are described. Their contributions are given as proportions of intakes from food sources only.

Information on consumption of dietary supplements was collected both in the four-day food diary and in the Computer Assisted Personal Interview (CAPI), which asked about dietary supplement consumption in the year before the interview. Dietary supplements were defined for parents as products intended to provide additional nutrients or give health benefits and taken in liquid, powder, tablet or capsule form. In the diary, parents wrote down the details of any supplements they gave to their children on each diary recording day. In the CAPI, parents were asked to list any dietary supplements given to their children over the past year.

Intakes of vitamins and minerals by socio-economic category and ethnic group are reported in two ways: intakes from all sources, that is, including supplements as recorded in the four-day food diary, and for recommended vitamins (A, C and D), from food sources only. The percentage contribution of the major food types to selected vitamins and minerals are shown.

For a full introduction to Dietary Reference Values (DRVs), that is Reference Nutrient Intakes (RNIs) and Lower Reference Nutrient Intakes (LRNIs), and an explanation of how they have been used in this report, refer to section 6.4.

Results in Chapter 7 were tested at the 95% significance level (and only statistically significant differences are highlighted in the text) by comparing means, and where foods and nutrients are not normally distributed, by comparing proportions of children above and below the overall median value. Mean, median and Standard Error (SE) has been presented and, for consistency with other chapters, discussions refer to the mean. The reference category for the comparisons by socio-economic categories was managerial and professional, and for ethnic group was white unless it was appropriate to denote a different reference category. Any change to the reference category is stated in the text and shown in tables.

7.2 Variations by socio-economic category

7.2.1 Vegetable, fruit, meat and fish consumption, including from composite dishes

Mean daily consumption of vegetables based on disaggregated data varied with socio-economic position with significantly higher consumption in the managerial and professional category compared to the intermediate category for children aged 4 to 11 months (87g vs. 72g), the routine and manual category for children aged 4 to 11 months (87g vs. 65g) and for the routine and manual category for children aged 12 to 18 months (83g vs. 65g). Mean daily fruit consumption (not including fruit juice) was also significantly higher for those in the managerial and professional category compared to the routine and manual category for those aged 4 to 11 months (87g vs. 56g) and for those aged 12 to 18 months (122g vs. 74g). Total fruit (not including fruit juice) and vegetables showed the same patterns, with significantly higher consumption in the managerial and professional category compared to the intermediate and routine and manual categories.

There were no significant variations with socio-economic category for meat consumption based on disaggregated data for either those aged 4 to 11 months or those aged 12 to 18 months. Consumption of fish was very low for all children; for those aged 4 to 11 months, there was a small but significantly lower consumption for those in the intermediate, routine and manual and non-classifiable categories compared to managerial and professional.

Table 7.2a

7.2.2 Supplements

The proportion of children aged 4 to 11 months given at least one supplement during the four-day food diary recording period ranged from 5% for those in the routine and manual occupation category to 12% for those in the non-classifiable category. For children aged 12 to 18 months, 22% of children in the non-classifiable category were given a supplement, statistically higher than 9% in the managerial and professional category. The most common type of supplement consumed was a multi-vitamin.

Table 7.3a

A higher proportion of parents reported having given at least one supplement to their child during the previous year than had done so in the four-day food diary period. For those aged 4 to 11 months, the proportion given at least one supplement over the past year ranged from 10% for those in the routine and manual category to 17% for the non-classifiable category, but there were no significant differences by category. For those aged 12 to 18 months, statistically more children in the non-classifiable category (39%) were given a supplement than those in the routine and manual category (16%) and managerial and professional category. The most common supplement given was a multi-vitamin.

Table 7.4a

7.2.3 Nutrient Intakes

In this section the commentary has been limited to two nutrients: energy because it is one of the few macronutrients for which a DRV is set for this age group and non-milk extrinsic sugars (NMES) because the pattern of consumption and sources of NMES in this age group are likely to differ to older children and adults and may vary by socio-economic category and/or ethnicity.

7.2.3.1 Energy

For children aged 4 to 11 months, mean energy intake was significantly higher in the managerial and professional category at 3.38 MJ (805 kcal) compared to 3.26 MJ (774 kcal) for children from the intermediate category and 3.27 MJ (776 kcal) for children in the routine and manual category. For children aged 12 to 18 months there were no significant differences by socio-economic category with energy intakes ranging from 4.10 MJ (975 kcal) for the managerial and professional and intermediate categories to 3.86 MJ (917 kcal) for the non-classifiable category.

Table 7.5a

Infant formula was the main source of energy for children aged 4 to 11 months for all socio-economic categories; children in the routine and manual category derived a significantly greater contribution (50%) from infant formula than children in the

managerial and professional category and intermediate category (44%). For children aged 12 to 18 months, infant formula contributed between 11% energy (intermediate category) to 14% energy (managerial and professional category) but there were no significant differences for this age group. There were few differences in the contribution from the food group 'commercial infant foods' to energy intakes by socio-economic category.

For those aged 12 to 18 months, the food group 'milk and milk products' was the main source of energy with no significant differences by socio-economic category. There was a significantly smaller contribution from fat spreads to energy intake for children in the intermediate and routine and manual categories (6% and 5% respectively) compared to the managerial and professional category (7%) and a greater contribution from the food group 'vegetables and potatoes' in the routine and manual category compared to the managerial and professional category (7% vs. 5%).

Table 7.6a

7.2.3.2. Non-milk extrinsic sugars (NMES)

For children aged 4 to 11 months, mean daily NMES intakes were significantly higher for those in the routine and manual category (13.1g, 6.3% energy) compared to those in the managerial and professional category (11.6g, 5.4% energy). There were no significant differences by socio-economic category for NMES intakes for children aged 12 to 18 months; mean NMES intake ranged from 18.9g per day for the managerial and professional category to 20.6g per day for the non-classifiable category.

For children aged 4 to 11 months, the main contributor to NMES intake for those in the managerial and professional (39%) was the food group 'milk and milk products', significantly higher than for those in the routine and manual category (29%). The food group 'commercial infant foods' made the greatest contribution for children in the routine and manual category (36%) compared to the managerial and professional category (29%).

For children aged 12 to 18 months the contribution from the food group 'commercial infant foods' was significantly higher for the managerial and professional category (18%) than for routine and manual category (14%) and the contribution from beverages was significantly higher for the intermediate category (12%) compared to the managerial and professional category (9%).

Table 7.7a

7.2.4 Micronutrient intakes

7.2.4.1. Vitamins

In spite of some statistical differences between socio-economic categories, mean daily intakes of most vitamins met the RNI and have therefore not been described in detail.

For non-breastfed children, mean daily intake of vitamin D was above the RNI for those aged 4 to 11 months and below the RNI for those aged 12 to 18 months with no significant differences by socio-economic category. For breastfed children (by any degree of breastfeeding, excluding the contribution from breast milk) mean daily intake of vitamin D did not meet the RNI for either age group, although this is an underestimation of vitamin D intakes for this group. For those aged 4 to 11 months, vitamin D intake was significantly higher in children in the managerial and professional category (50% of the RNI) than those in the intermediate category (33% of the RNI). The number of breastfed children were small and this should be borne in mind when interpreting statistical comparisons.

Mean intakes of vitamins A, C and D were little affected by considering food sources only.

Tables 7.8a to 7.12a

The largest contributor to vitamin A intake for children aged 4 to 11 months was infant formula, and there were no significant differences by socio-economic category. The food group 'vegetables and potatoes' contributed significantly more (18%) to vitamin A intake for those in the managerial and professional category than to those in the routine and manual category (13%). The contribution from the food group 'commercial infant foods' was 12% of vitamin A intake for those in the managerial and professional category, significantly lower when compared to 15% in the intermediate category and 18% in the routine and manual category.

For those aged 12 to 18 months, the food group 'milk and milk products' made the largest contribution to vitamin A, ranging from 19% to 23% of intake, followed by the food group 'vegetables and potatoes' from 16% to 20%, and infant formula from 15% to 18%. Children of this age in the managerial and professional category (18%) had a significantly higher vitamin A intake from 'vegetables and potatoes' than the intermediate category (16%).

Table 7.13a

There were few significant differences by socio-economic category for contributions to folate intake. Infant formula was the main contributor for children aged 4 to 11 months for all socio-economic categories. For those aged 12 to 18 months, the food group 'milk and milk products' was the major source, ranging from 21% to 23% of

folate intake, followed by the food group 'cereals and cereal products' at 15% to 16%, infant formula from 13% to 17%, and the food group 'vegetables and potatoes', from 13% to 14%. None of these were significantly different by socio-economic category, however the food group 'commercial infant foods' contributed 7% of the total folate intake for managerial and professional category and significantly less for the routine and manual category at 6%.

Table 7.14a

The major contributor to vitamin D intake for non-breastfed children for both age groups was infant formula, ranging from 79% to 84% of intake for children aged 4 to 11 months, and 27% to 33% for those aged 12 to 18 months, with infant formula contributing significantly less to vitamin D intake for those in the routine and manual category compared to the managerial and professional category. For those aged 4 to 11 months, the food group 'milk and milk products' contributed significantly more to vitamin D intake for those in managerial and professional category (4%) than for routine and manual (3%) category. The food group 'fish and fish dishes' contributed significantly more for those in the managerial and professional category (3%) than for intermediate (1%) and routine and manual (2%) categories for those aged 4 to 11 months and, for those aged 12 to 18 months significantly more (11%) than for intermediate (10%) and routine and manual (5%) categories.

Table 7.15a

There were few variations with socio-economic category for the intake of other vitamins for either the 4 to 11 months or 12 to 18 months age groups. Sources of intakes for these other vitamins were not examined.

7.2.4.2. Minerals

Whilst there were some statistical differences between socio-economic categories, mean daily intakes of most minerals met the RNI and have therefore not been described in detail. There were no significant differences in mean daily intakes or as a percentage of the RNI by socio-economic status for calcium or zinc, for both the 4 to 11 months and the 12 to 18 months age groups. For children aged 12 to 18 months, there was an increasing percentage below the LRNI with decreasing socio-economic status for both iron and zinc. For iron, 8% of those in the managerial and professional category had intakes below the LRNI, significantly lower than 14% of those in the intermediate category and 17% of those in the routine and manual category. For zinc, 2% of those in the managerial and professional category had intakes below the LRNI, significantly lower than the routine and manual category at 6%.

Tables 7.16a to 7.18a

The main source of iron for those aged 4 to 11 months was infant formula, ranging from 56% to 61%, with no significant differences by socio-economic category. The contribution of the food group 'commercial infant foods' was significantly lower for children in the managerial and professional category (12%) than for the intermediate category (15%), and the routine and manual category (14%). The food group 'vegetables and potatoes' contributed significantly more to iron intake for the managerial and professional category (5%) than for the routine and manual category (4%). For those aged 12 to 18 months, the main contributors were the food group 'cereals and cereal products' (27% to 29%) and infant formula (19% to 24%), but these were not significantly different by socio-economic category. For this age group, 'commercial infant foods' contributed significantly more for the managerial and professional category (12%) than for the routine and manual category (11%).

Table 7.19a

The main contributor to calcium intake was infant formula for children aged 4 to 11 months. Children from the routine and manual category (55%) derived significantly more calcium from infant formula than those in the managerial and professional category (50%). The contribution from the food group 'commercial infant foods' was significantly lower for the managerial and professional category (8%) than for the intermediate (10%) and routine and manual (11%) categories. For children aged 12 to 18 months, the main category contributing to calcium intake was the food group 'milk and milk products' (52% to 54%) followed by infant formula (16% to 19%), but there were no significant differences by socio-economic category.

Table 7.20a

As seen for iron, the main source of zinc was infant formula for those aged 4 to 11 months and there were no significant differences by socio-economic category. For those aged 12 to 18 months, the main contributors to zinc intake were the food groups 'milk and milk products' (29% to 31%) and infant formula (18% to 21%), but these were not significantly different by socio-economic category.

Table 7.21a

There were no significant differences in sodium intake between socio-economic categories for either age group. Infant formula was the main contributor to sodium intake for children aged 4 to 11 months, ranging from 29% to 34% of intake followed by the food group 'cereals and cereal products' (12% to 14%), with no significant differences by socio-economic category. For children aged 12 to 18 months, sodium intake from the food group 'milk and milk products' was significantly higher for those in the managerial and professional category (21%) than for children in the routine and manual category (18%). The food groups 'cereals and cereal products' (17% to 18%) and 'meat and meat products and dishes' (14% to 18%) were also main contributors, with children in the managerial and professional category (14%) having a significantly

lower intake of sodium from 'meat and meat products' when compared to the routine and manual category (18%).

Table 7.22a

For magnesium, potassium, copper, selenium and iodine, intakes varied little with socio-economic category, both for intake in milligrams per day and as a percentage of the RNI, for both those aged 4 to 11 months and those aged 12 to 18 months

7.3 Variations by ethnic group

7.3.1 Vegetable, fruit, meat and fish consumption, including from composite dishes

For children aged 4 to 11 months, mean daily consumption of vegetables based on disaggregated data was significantly lower for South Asian (58g) and 'other' children (68g) compared to white children (77g) but there were no significant differences by ethnic group for fruit (not including fruit juice) consumption. Total daily fruit and vegetable consumption was also significantly lower for South Asian children (116g) compared to white children (149g).

For children aged 12 to 18 months, daily vegetable consumption was significantly lower for 'other' children (69g) than for white children (76g). Fruit consumption (not including fruit juice) was significantly lower for South Asian children (79g) and 'other' children (83g) compared with white children (99g). Mean daily total fruit (not including fruit juice) and vegetable consumption was significantly lower for South Asian (140g) and 'other' children (152g) compared with white children (175g).

Meat consumption per day was significantly lower for South Asian children (10g) than for white children (17g) for those aged 4 to 11 months, and for both South Asian (21g) and 'other' children (24g) compared to white children (31g) for those aged 12 to 18 months. Consumption of fish was low for all children and there were no significant differences by ethnic group.

Table 7.2b

7.3.2 Supplements

When tested statistically, more South Asian and 'other' children were given at least one supplement during the four-day food diary recording period than white children for both those aged 4 to 11 months and 12 to 18 months. For children aged 12 to 18 months, the proportion given a supplement was 8% for white children, significantly lower than South Asian children at 19% and 18% of 'other' children. The most common type of supplement consumed was a multi-vitamin, and significantly more South Asian and 'other' children were given these than white children for both those aged 4 to 11 and 12 to 18 months

Table 7.3b

A higher proportion of parents reported having given at least one supplement to their children during the previous year than had done so in the four-day food diary period. For children aged 4 to 11 months, significantly more South Asian children (20%) were given a multi-vitamin than white children (8%) and for children aged 12 to 18 months, significantly more South Asian (20%) and 'other' children (27%) were given a multi-vitamin supplement than white children (11%).

Table 7.4b

7.3.3 Energy

Mean energy intake ranged from 3.33 MJ (793 kcal) to 3.15 MJ (749 kcal) for children aged 4 to 11 months with no significant difference by ethnic group. For those aged 12 to 18 months, white children consumed significantly more energy (4.11 MJ, 977 kcal) than 'other' children (3.83 MJ, 909 kcal).

Table 7.5b

There were few ethnic differences in the contributions to energy intake from different food groups for children aged 4 to 11 months. Infant formula provided the greatest contribution (43% to 47%), with a significantly higher intake for white children than 'other' children of this age group. For those aged 12 to 18 months, the food group 'milk and milk products' was the greatest source of energy for all children; white children derived a significantly greater contribution from these (24%) than 'other' children (22%). Although the contribution to energy was small (2% to 6%), South Asian and 'other' children had significantly lower contributions from fat spreads for both children aged 4 to 11 months and 12 to 18 months.

Table 7.6b

7.3.4 Non-milk extrinsic sugars (NMES)

For children aged 4 to 11 months, there was no significant difference in mean daily NMES intake by ethnicity, whereas for children aged 12 to 18 months mean daily NMES intake was significantly lower for South Asian children (15.3g, 5.9% energy) compared to white children (20.4g, 7.9% energy).

For children aged 4 to 11 months, the main contributor to NMES intake for white children was the food group 'milk and milk products' (35%), significantly higher than for South Asian (26%) and 'other' children (30%). The food group 'commercial infant foods' made the greatest contribution to South Asian at 42% and 'other' children at 43%, compared to 30% for white children, the difference between white and 'other' children was significant.

For children aged 12 to 18 months, the food group 'milk and milk products' was the greatest contributor to NMES intake for all children (26% to 32%), with no significant variation by ethnic group. The food group 'commercial infant foods' was the next largest contributor for South Asian and 'other' children at 18% and 21% respectively, compared to 16% for white children, for whom the food group 'cereals and cereal products' was the second largest contributor at 17%, significantly higher when compared to 13% for South Asian and 14% for 'other' children.

Table 7.5b and 7.7b

7.3.5 Micronutrient intakes

7.3.5.1. Vitamins

In spite of some statistical differences between ethnic groups, mean daily intakes of most vitamins met the RNI and have therefore not been described in detail. For non-breastfed children, mean daily intake of vitamin D from all sources (including supplements) was above the RNI for those aged 4 to 11 months with no significant differences by ethnic group, and below the RNI for those aged 12 to 18 months, with significantly lower intakes for white children (52% of the RNI) than 'other' children (80% of the RNI). For breastfed children (by any degree of breastfeeding, excluding the contribution from breast milk) mean daily intake of vitamin D did not meet the RNI for any ethic group, with significantly lower intakes for white children aged 4 to 11 months (46% of RNI) compared to South Asian children (69%) of the same age.

Tables 7.8b to 7.12b

The largest contributor to vitamin A intake for all children aged 4 to 11 months was infant formula, and was significantly lower for 'other' children at 42% of vitamin A, compared to white children at 45%. There were few other differences in main contributors to vitamin A by ethnicity for this age group. For those aged 12 to 18

months, the food group 'milk and milk products' made the largest contribution to vitamin A, ranging from 19% for 'other' children to 21% for white children and 29% for South Asian children. The contribution from fat spreads was significantly higher for white children (14%) than for South Asian children (11%) and 'other' children (8%). The contribution to vitamin A intake from the food group 'vegetables and potatoes' was significantly higher for white children (18%) than for South Asian children (11%). 'Other' children had a significantly greater contribution from infant formula in this age group at 24% of vitamin A, compared to 16% for white and South Asian children.

Table 7.13b

There were few significant differences by ethnic group for contributions to folate intake. Infant formula was the main contributor for all children aged 4 to 11 months, ranging from 48% to 51%. For those aged 12 to 18 months, the food group 'milk and milk products' was the major source, ranging from 20% to 30% of folate intake, followed by infant formula from 14% to 22%, with a significantly lower contribution for white children (15%) compared to 'other' children (22%). The food group 'cereals and cereal products' made a significantly greater contribution for white children (16%) than for South Asian or 'other' children (both 13%). South Asian children also had a significantly lower contribution from the food group 'vegetables and potatoes' at 11% of folate intake, compared to white children at 14%.

Table 7.14b

The major contributor to vitamin D intake for non-breastfed children of both age groups was infant formula, ranging from 80% to 83% with no significant differences by ethnic group for those aged 4 to 11 months, but significantly higher for 'other' children (43%) than for white children (30%) for those aged 12 to 18 months. Fat spreads made a major contribution to vitamin D intakes, with white children (20%) having significantly greater contributions than South Asian (14%) and 'other' children (10%) or children aged 12 to 18 months. The contribution of the food group 'meat and meat products' to vitamin D intake for non-breastfed children aged 12 to 18 months was also significantly higher for white children (13%) than for South Asian (6%) and 'other' children (8%).

Table 7.15b

There were few variations with ethnic group for the intake of other vitamins, for those aged 4 to 11 months. For children aged 12 to 18 months, South Asian children had significantly lower intakes of thiamin than white children, and 'other' children had significantly lower intakes of vitamin B_{12} and folate than white children. Sources of intakes for these other vitamins were not examined.

Tables 7.7b to 7.14b

7.3.5.2. Minerals

Whilst there were some statistical differences between ethnic groups, mean daily intakes of most minerals met the RNI across the sample and have therefore not been described in detail. There were no significant differences in iron intake by ethnic group in milligrams per day or as a percentage of the RNI, for both the 4 to 11 month and 12 to 18 month age groups. For those aged 12 to 18 months, there were significantly more South Asian (28%) and 'other' (19%) children than white children (11%) below the LRNI for iron.

Tables 7.16b to 7.18b

There were few significant differences by ethnic group in sources of iron for those aged 4 to 11 months. The main source was infant formula, ranging from 54% to 58%. For those aged 12 to 18 months, the contribution of the food group 'cereals and cereal products' was significantly lower for 'other' children (22%) than white children (28%), while 'other' children had a greater contribution from infant formula (32%) than white children (21%). Both South Asian (9%) and 'other' children (7%) had a significantly lower contribution from the food group 'meat and meat products' than white children (10%).

Table 7.19b

The main contributor to calcium intake was infant formula for children aged 4 to 11 months, with a significantly lower contribution at 48% of intake for 'other' children compared to 52% of intake for white children. The food group 'milk and milk products' contributed from 18% to 20% of calcium intake but there were no significant differences by ethnic group. For children aged 12 to 18 months, the main contributor was 'milk and milk products', which was significantly higher for white children (53%) than 'other' children (47%); 'other' children had a significantly greater contribution from infant formula (25%) than white children (18%). White children aged 12 to 18 months obtained significantly more calcium from the food group 'cereals and cereal products' (10%) than both South Asian (7%) and 'other' children (9%).

Table 7.20b

As for iron, the main source of zinc for those aged 4 to 11 months was infant formula, which made a significantly larger contribution for white children (57%) than for 'other' children (51%). For those aged 12 to 18 months, the main contributor was the food group 'milk and milk products', which was significantly lower for 'other' children (25%) compared to white children (30%), and infant formula, which made a significantly higher contribution for 'other' children (28%) compared to white children (20%). White children obtained significantly more zinc from the food group 'meat and meat products and dishes' (16%) than South Asian (11%) and 'other' children (12%).

Table 7.21b

For those aged 4 to 11 months, daily sodium intakes were significantly higher for white children (453mg) than for South Asian children (352mg), and for those aged 12 to 18 months the sodium intakes of white children were significantly higher (948mg) than for South Asian (700mg) and 'other' children (754mg). For those aged 4 to 11 months, infant formula was the main contributor to sodium intake, ranging from 31% to 35% of intake, with no significant differences by ethnic group. The food group 'cereals and cereal products' contributed significantly more to sodium intake for white children (14%) than for South Asian children (11%). For children aged 12 to 18 months, the food groups 'milk and milk products' (19% to 27%) and 'cereals and cereal products' (17% to 18%) were the largest contributors with no differences by ethnic group. The food group 'meat and meat products' contributed significantly more to sodium intake for white children (17%) than for South Asian (8%) and 'other' (13%) children, as did the food group 'miscellaneous' foods, which would include many snack items (11% for white children, 8% for South Asian, 9% 'other'). Although the contributions were small (2% to 5%), fat spreads contributed significantly more to sodium intake for white children for both those aged 4 to 11 months and those aged 12 to 18 months than for South Asian and 'other' children.

Table 7.22b

'Other' children had significantly lower potassium intakes than white children for both those aged 4 to 11 months and 12 to 18 months. For those aged 12 to 18 months, both South Asian and 'other' children had significantly lower magnesium intakes than white children, and 'other' children also had significantly lower copper and iodine intakes than white children. Sources of these minerals were not examined.

Tables 7.16b to 7.22b

Chapter 8 Blood analytes

Summary of findings

- Thirteen per cent of children aged 5 to 11 months and 15% aged 12 to 18 months had haemoglobin concentrations below the lower reference limits.
- The proportion of children with a serum ferritin concentration below the lower reference limit was 7% for those aged 5 to 11 months and 11% for those aged 12 to 18 months.
- The proportion of children with haemoglobin concentrations and serum ferritin concentrations below which iron deficiency anaemia is indicated was 3% for those aged 5 to 11 months and 2% for those aged 12 to 18 months.
- Six per cent of children aged 5 to 11 months and 2% aged 12 to 18 months had 25-hydroxyvitamin D (25-OHD) concentrations below the lower threshold for vitamin D adequacy.

8.1. Introduction

Results in this chapter are presented for two age groups, 5 to 11 months and 12 months and over, as the youngest child to provide a blood sample was aged 5 months. Samples were collected between February and August 2011. The results in Chapter 6 are based on assessment of food consumption over four days and indicate dietary intake over a short period. Analysis of blood samples provides an indication of the nutritional status of the population usually over a long period. Nutritional status means the level of nutrients available to the body (after absorption) for use in metabolic processes and in this age group includes stores acquired in utero. In the Diet and Nutrition Survey of Infants and Young Children (DNSIYC), dietary intake therefore cannot be compared directly to nutritional status, as status does not just reflect the intake of nutrients from the diet.

An overview of the purpose, methodologies and other procedures associated with obtaining blood samples from participants, as well as the response rates achieved, are provided in Chapters 1 and 2 and Appendices A and O. Appendix I contains examples of consent forms and Appendix K contains examples of the feedback letters sent to a participant's parent and/or their GP containing results for reportable analytes measured in the blood sample. Appendix O details the laboratory quality control data and methodology of blood analysis for each analyte described in this report.

8.1.1. Blood priority order

The order of priority for analysis was the Full Blood Count (FBC), followed by vitamin D, iron status (serum ferritin and transferrin receptors) and finally C-Reactive Protein (CRP). Apart from haemoglobin concentrations, the results for the FBC and CRP are not provided in this report. FBC results can be found in Appendix N (Detailed Haematology results). The CRP results were used only in the interpretation of iron status.

8.1.2. Obtaining the blood sample

Each parent of a fully productive participant was asked to attend a clinic visit with the child and to give consent for the child to provide a blood sample. Results are available for each child who attended a clinic visit, consented and provided a blood sample. A blood sample was consented to for 828 children (37%) of the DNSIYC UK sample eligible to attend Stage 2 (clinic visit)[1]. Of those who consented to this procedure, blood was attempted but unsuccessful for 223 children (27%) and was successfully obtained for 531 children (64%). For 74 children (9%) whose parents consented, blood sampling was not attempted, mainly due to there being no suitable vein or due to the child being too distressed. Of those from whom a blood sample was obtained, 88% provided a full set of two tubes (EDTA and serum). In total, FBC was successfully measured in 496 children (22% of the DNSIYC UK sample), vitamin D in 463 children (21%), serum ferritin in 463 children (22%) and transferrin receptors in 460 children (22%). In 18 cases (1%) where a blood sample was obtained, analysis was unsuccessful for FBC, vitamin D and iron status. The main reason for unsuccessful analysis was insufficient volume of blood obtained.

8.1.3. Analysis of blood analytes

Weighting factors have been applied to the blood analyte data in Tables 8.2.1 and 8.2.2 (and Appendix N) to account for differential non-response to providing a blood sample, in order to adjust for any bias arising from unsuccessful blood sampling and/or refusals. Details of the weighting factors are provided in Appendix B. Notional values were assigned to results below the limit of detection. These were calculated by dividing the analytical limit of detection by the square root of two. This method is consistent with that used in NHANES and has been described by Hornung and Reed (1990)[2].

8.2. Representativeness of those who gave blood compared to entire sample

A total of 513 usable samples were collected from participating children, 490 from core sample members and 23 from children selected as part of the Healthy Start (HS) boost sample. A comparison was made between the profile of the core sample members who gave blood and the DNSIYC UK population. The 23 HS boost sample members were excluded from this comparison because they were not selected from

the Child Benefit (CB) record data. However, data for these individuals were included in the overall blood results, since the final weighting factors ensured the combined core and HS sample members were representative of the UK population.

The parents of children who gave blood tended to be older than parents of the same aged children in the UK population. This was a result of lower rates of clinic attendance amongst younger mothers. There were also some regional variations due to regional differences in response and clinic attendance. However, the two profiles (those who went to clinic and the DNSIYC UK population) were generally close and there was no evidence of large biases.

Table 8.1

8.3. Blood analytes, by age

8.3.1. Iron status analytes

Ferritin is an intracellular protein that stores iron. Serum ferritin gives an indication of the level of iron stores. However, serum ferritin is an acute phase reactant that is raised in response to infection or inflammation. Therefore serum ferritin concentrations should be interpreted with care as they can be raised by recent infections or inflammatory conditions and other chronic disorders[3].

The lower limit for serum ferritin below which iron stores are considered to be depleted and the risk of iron-deficiency anaemia increased is 9µg/L for children aged 5 to 6 months, 5µg/L for children aged 7 to 9 months and 12µg/L for children aged 10 months or over[3,4].

For children for whom there was a serum sample, the mean serum ferritin for those aged 5 to 11 months was 37µg/L and was 28µg/L for those aged 12 to 18 months There were 11 (7%) children aged 5 to 11 months and 31 (11%) children aged 12 to 18 months who were below the age-related lower serum ferritin reference limits.

The transferrin receptor aids the uptake of transferrin-bound iron into cells, especially during the production of erythrocytes (red blood cells) in the bone marrow. The concentration of soluble transferrin receptor circulating in the blood is raised when there is increased demand for iron in the tissues. This may be attributable to low intracellular iron concentrations or to physiological factors (e.g. growth, increased haematopoiesis). Unlike ferritin, this concentration is not affected by the acute phase reaction and therefore, facilitates the detection of iron deficiency anaemia in the presence of anaemia caused by chronic illness or inflammation.

The upper limit for transferrin receptors above which iron stores are considered to be depleted and the risk of iron-deficiency anaemia increased is 11µg/mL for all age groups in DNSIYC. These upper limits for transferrin receptors have been set by

Domellof *et al*, 2002[5] and are endorsed by the Scientific Advisory Committee on Nutrition (SACN)[3].

The mean transferrin receptor concentration was 6.9µg/mL for children aged 5 to 11 months and 8.6µg/mL for children aged 12 to 18 months. There were 10 children (6%) aged 5 to 11 months and 44 children (15%) aged 12 to 18 months who were above the upper transferrin receptor reference.

Haemoglobin is the iron-containing, oxygen-carrying, molecule in erythrocytes. Circulating levels of haemoglobin are indicative of the oxygen-carrying capacity of the blood and a low haemoglobin concentration can indicate iron deficiency (anaemia).

The lower limits for haemoglobin below which anaemia is indicated are 10.5g/dL, 10.0g/dL and 11.0g/dL for children aged 0 to 6 months, 7 to 9 months and 10 months or over, respectively. These lower limits for haemoglobin have been set by the World Health Organization (WHO)[4] and are endorsed by SACN[3].

Haemoglobin was measured as part of the FBC for children who provided an EDTA sample. The mean haemoglobin concentration was similar in each age group, at 11.5g/dL for children aged 5 to 11 months and 11.7g/dL for children aged 12 to 18 months. There were 23 (13%) children aged 5 to 11 months and 50 (15%) children aged 12 months or over who fell below the lower haemoglobin reference limit.

Table 8.2.1

Haemoglobin and serum ferritin, in combination, are considered to be the most useful indicators of iron status[6,7]. In DNSIYC, five (3%) children aged 5 to 11 months and seven (2%) children aged 12 to 18 months indicated iron deficiency anaemia[8].

8.3.2. Vitamin D

Plasma 25-hydroxyvitamin D (25-OHD) is a measure of vitamin D status and reflects the availability of vitamin D in the body from both dietary and endogenous sources. Plasma 25-OHD is derived from synthesis in the skin of cholecalciferol during ultraviolet B irradiation from sunlight and from ergocalciferol and cholecalciferol in the diet. 25-OHD concentrations are therefore influenced by factors such as the season (lowest in winter and spring), habit of dress and time spent outdoors, as well as intake from foods and supplements. Vitamin D, after conversion to its active metabolites, facilitates calcium absorption from the intestine and is important for a range of other metabolic processes.

In the UK, 25 nmol/L of 25-OHD has been set as the lower threshold for vitamin D adequacy below which there is an increased risk of rickets and osteomalacia[9,10]. It has been suggested that a higher value should be used to indicate the lower threshold of population vitamin D sufficiency but there is currently no consensus on which value

should be selected. In 2011, SACN convened a working group to review the dietary reference values (DRVs) for vitamin D and make recommendations[11]. SACN's review will include consideration of the validity of the threshold concentrations/ranges used to assess risk of deficiency and excess. SACN is expected to complete its review in 2014. Collection of blood samples in DNSIYC was not spread evenly across the year (Wave 1 was largely in February to May and Wave 2 was largely in April to August); hence values in Table 9.3.2 are not year-round averages.

For children for whom there was a serum sample, the mean 25-OHD concentration for those aged 5 to 11 months was 68.6nmol/L and 64.3nmol/L for those aged 12 to 18 months. Ten children (6%) aged 5 to 11 months and five children (2%) aged 12 to 18 months were below the lower threshold of population vitamin D sufficiency. Of those below the lower threshold of population vitamin D sufficiency, all those aged 5 to 11 months were still breastfeeding at the time of the Stage 1 interview. None of the children below the lower threshold of vitamin D sufficiency aged 12 to 18 months were still breastfeeding at the time of the Stage 1 interview. Children below the threshold of population vitamin D sufficiency were not limited to any one ethnic group (11 white, two South Asian, and three of 'other' ethnicity[12]).

Table 8.2.2

8.3.3 Comparisons with other data

Mean haemoglobin concentrations in DNSIYC (11.5g/dL and 11.7g/dL in children aged 5 to 11 months and 12 to 18 months, respectively) were very similar to data from the Avon Longitudinal Study of Parents and Children (ALSPAC)[13,14] a cohort from the South West region of England that began in 1991/2 and where blood samples were analysed at different ages. Haemoglobin values in that study were 11.7g/dL in children aged 8 months; 11.7 and 11.8g/dL for males and females aged 12 months; and 11.6 and 11.8g/dL for males and females aged 18 months.

Mean ferritin concentrations in DNSIYC (37µg/L and 28µg/l in children aged 5 to 11 months and 12 to 18 months, respectively) were also similar to ALSPAC data (37.7µg/l in children aged 8 months; 31.9µg/l at 12 months; and 26.4µg/l at 18 months).

Comparisons should be interpreted with caution as the method of obtaining a blood sample differed in ALSPAC, where capillary blood samples were taken. These are recognised to produce lower haemoglobin concentrations than equivalent venous samples[15]. There are no other recent blood data from surveys in the UK of this age group.

References and endnotes

[1] Scotland boost not included (n=2683-455) because Scotland was a dietary survey only.

[2] Hornung RW, Reed LD. Applied Occupational and Environmental Hygiene, 1990, 5: 46-51

[3] Scientific Advisory Committee on Nutrition (SACN). *Iron and Health*. The Stationery Office (London, 2010). Available online: http://www.sacn.gov.uk/pdfs/sacn_iron_and_health_report_web.pdf

[4] World Health Organization. Iron Deficiency Anaemia; Assessment, Prevention, and Control: A guide for programme managers. WHO (Geneva, 2001).

[5] Domellof M, Dewey KG, Lonnerdal B, Cohen RJ, Hernell O. The diagnostic criteria for iron deficiency in infants should be reevaluated. *J Nutr.* 2002; 132:3680–6

[6] World Health Organization. Centers for Disease Control and Prevention. Assessing the Iron Status of Populations. Geneva: WHO, 2004.

[7] Endorsed by the Committee on Medical Aspects of Food and Nutrition Policy (COMA) in 1994.

[8] The number of participants with haemoglobin and ferritin results differed. The base for haemoglobin was used to calculate the percentage of children indicating anaemia.

[9] Department of Health Report on Health and Social Subjects, No. 49. Nutrition and bone health with particular reference to calcium and vitamin D. TSO(London, 1998)

[10] Bates CJ, Carter GD, Mishra GD, O'Shea D, Jones J, Prentice A. In a population study, can parathyroid hormone aid the definition of adequate vitamin D status? A study of people aged 65 years and over from the British National Diet and Nutrition Survey. Osteoporosis International, 2003; 14: 152-9

[11] http://www.sacn.gov.uk/meetings/working_groups/vitamin/28062012.html

[12] The number of children below the 25-OHD reference limit has changed due to rounding.

[13] Emond AM, Hawkins N, Pennock C, Golding J and the ALSPAC Children in Focus Team. Haemoglobin and ferritin concentrations in infants at 8 months of age. Archives of Disease in Childhood. 1996: 74, 36-39

[14] Sheriff A, Emond A, Hawkins N, Golding J and ALSPAC Children in Focus Study Team. Haemoglobin and ferritin concentrations in children aged 12 and 18 months. Archives of Disease in Childhood. 1999: 80, 153-157)

[15] Dallman PR, Reeves, J. Laboratory diagnosis or iron deficiency. In: Stekel A, ed. Iron nutrition in infancy and childhood. New York: Raven Press, 1984: 25-6