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What is known about maternal and infant nutrition in Scotland?

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Foreword

There is now a large body of evidence demonstrating the long-term effects of the mother's nutrition before and during pregnancy, the type of milk feeding and the foods received early in life. The Scottish Government will shortly publish a strategy and action plan to improve maternal and infant nutrition. This epidemiology briefing will be a central component of the strategy and provides an overview of the data currently available on maternal and infant nutrition.

It is clear from the review that, although we have relatively good data on breastfeeding rates in Scotland, we have limited data on the nutrition of women during and after pregnancy, and on the types of foods given to young children. This review will assist in stimulating the debate required to determine how best these gaps can be addressed.

Ruth Campbell RD, RPHNutr
Infant Nutrition Co-ordinator
Scottish Government

Authorship

Louise Flanagan, Public Health Information Manager, Public Health Observatory Division, NHS Health Scotland – lead author

David Gordon, formerly Head of Public Health Observatory Division, NHS Health Scotland – author and editor

With the assistance of:

Julie Armstrong, Senior Lecturer in Public Health Nutrition, Glasgow Caledonian University

Ruth Campbell, Infant Nutrition Co-ordinator, Scottish Government

Anne Milne, Scientific Advisor, Food Standards Agency Scotland

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For further information about this publication contact louiseflanagan@nhs.net

Scottish Public Health Observatory (ScotPHO) collaboration

The Public Health Observatory Division at NHS Health Scotland is part of this collaboration, led by ISD Scotland and NHS Health Scotland, that brings together key national organisations in public health intelligence in Scotland. We are working closely together to ensure that the public health community has easy access to clear and relevant information and statistics to support decision making. For further information, please see the ScotPHO website at www.scotpho.org.uk

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Abbreviations

25-OHD	25-hydroxyvitamin D
ALSPAC	Avon Longitudinal Survey of Parents and Children
BMI	body mass index
CHSP-PS	Child Health Systems Programme - Pre-School
COMA	Committee on Medical Aspects of Food
DoH	Department of Health
IFS	Infant Feeding Survey
ISD Scotland	Information Services Division Scotland
FSA	Food Standards Agency
FSAS	Food Standards Agency Scotland
GUS	Growing Up in Scotland
LIDNS	Low Income Diet and Nutrition Survey
LRNI	lower reference nutrient intake
NDNS	National Diet and Nutrition Survey
NDNS (1½ to 4½ years)	National Diet and Nutrition Survey: Infants aged 1½ to 4½ years
NTD	neural tube defect
RNI	reference nutrient intake
SACN	Scientific Advisory Committee on Nutrition
SHeS	Scottish Health Survey
SIMD	Scottish Index of Multiple Deprivation
SWS	Southampton Women's Survey
WHO	World Health Organization

Units used in this report and their abbreviations

µg	micrograms
µg/day	micrograms per day
g	grams
g/day	grams per day
g/dl	grams per decilitre
g/l	grams per litre
mg	milligrams
mg/day	milligrams per day
mg/l	milligrams per litre
ml	millilitres
nmol/l	nanomoles per litre
kcal	kilocalories
kg/m^2	kilogram per metre squared

Summary

- The Scottish Government is developing a strategy to improve maternal and infant nutrition. To inform the strategy, this review describes what is known about maternal and infant nutrition in Scotland, using routine data sources for Scotland wherever possible.
- There are limited data available. UK diet and nutrition surveys to date have had very small Scottish samples which were not adequately representative of the Scottish population and were conducted very infrequently. Conversely, current health surveys in Scotland with large sample sizes have limited dietary data. Different sources report their results in different ways, making interpretation and comparison difficult.
- Women are advised to comply with general healthy eating advice before and during pregnancy. Survey data suggest little improvement in the general diet of the population. In 2008, a high proportion of women consumed too much saturated fat and sugar, while consumption of fruit and vegetables and oil-rich fish was well below recommended levels. Women from deprived households were more likely to exhibit poor dietary patterns, and as a result were at greater risk of inadequate micronutrient status at conception and during pregnancy.
- Women should begin their pregnancy with a healthy body weight. Over one-half (52%) of women aged 16–44 years were overweight or obese in 2008.
- There are increased requirements for a number of micronutrients during pregnancy and breastfeeding. This review has therefore focused on key micronutrients that are of specific concern: vitamin D, folate, iron and calcium.
- There were limited Scottish and UK data available to describe the nutritional status of women during pregnancy and following the birth. However, data from national dietary surveys can indicate the nutritional status of women of childbearing age and their likely nutritional state at the start of pregnancy.
- Vitamin D requirements are increased during pregnancy and breastfeeding, and the recommendation is for women to take a daily supplement. There are no data available in Scotland or the UK on uptake of vitamin D supplementation during pregnancy or while breastfeeding. More than one-quarter (28%) of young women in the UK had low vitamin D status in 2000–2001.
- Before conception and until the 12th week of pregnancy, women are advised to take folic acid supplements. In addition to this, women are advised to increase their folate dietary intake by eating foods rich in folate and folic acid for the duration of their pregnancy. In 2005 a high proportion (77%) of women in Scotland reported taking a folic acid supplement at some point during the first three months of pregnancy. However, it is not clear whether the amount of folic acid taken and the timing was consistent with the advised level. Over 10% of women from low-income households in Scotland and the UK were deficient in folate in 2003–05.

- There is an increased demand for iron during pregnancy. Almost one-half (49%) of young women from low-income households in the UK had low iron intakes in 2003–2005, and 21% had low iron stores.
- A high proportion of women of childbearing age met the recommended intake of calcium in 2000–2001. However, 15% of women from low-income households in the UK had low calcium intake in 2003–2005.
- Survey data indicated that breastfeeding was initiated with 70% of infants but that there was a rapid fall-off over time, with only 44% breastfed at 6 weeks and 24% at 6 months in 2005. Routine data collected within the NHS suggested that 36% were breastfed at 6–8 weeks in 2008. However, the definition of breastfeeding differs for each source and makes direct comparison difficult.
- Sources differ on whether breastfeeding rates have increased in the past decade. The more comprehensive data source suggests no change. Mothers in the least deprived areas in Scotland are more likely to breastfeed than those in the most deprived areas, and breastfeeding is more likely to occur with older mothers.
- In 2005 over one-half of mothers in Scotland were using infant formula for almost all feeds by the time the infants were aged 4–10 weeks. Only 10% of mothers in Scotland prepared infant formula correctly in 2005. Follow-on formula should not be given before the infant is 6 months of age, but 10% of mothers in Scotland had given follow-on formula milk to their infant before this stage in 2005.
- There has been a general shift in Scotland towards mothers introducing solid foods at a later stage. By 4 months, 60% of mothers had introduced solid foods in 2005 compared with 83% of mothers in 2000.
- There are few recent data in the UK on the diet and nutrition of infants following weaning onto solid foods up to the age of 3 years and no data available in Scotland.
- There are neither sufficient nor sufficiently timely data available on maternal and infant nutrition in Scotland. Where possible, existing regular surveys and routine administrative data should be utilised and improved to monitor change in maternal and infant nutrition at population level.

1 Introduction

The quality of nutrition early in life is a vital component of each individual's resources for health in adult life.[1,2] The diet and nutritional status of the mother before conception and during pregnancy, the feeding received in the first few months of life, the process of weaning onto solid foods and the diet and nutritional status of the growing infant all contribute significantly to the long-term health of the population.[3] Maternal obesity increases the risk of complications for both the mother and the infant and predisposes to bigger, heavier infants.[1] A poor diet during pregnancy and early life has been linked to a range of conditions in later life, including cardiovascular disease, insulin resistance, type 2 diabetes and obesity.[1] Poor nutrition during these critical developmental stages can lead to impaired cognitive, physical and economic capacity that cannot subsequently be restored.[1]

The information available on maternal and infant nutrition in Scotland is limited, with only breastfeeding data available on a regular basis. Indeed, breastfeeding has been the focus of health improvement activity for many years.[4,5] The Scottish Government has adopted as policy the World Health Organization guidance recommending exclusive breastfeeding for the first 6 months of an infant's life.[6] Despite this, there has been only slight improvement in rates. The numerous benefits associated with breastfeeding for both mother and infant have been extensively evidenced and communicated, yet, in Scotland, fewer than one in four women breastfeed to 6 months.[7] Insofar as decisions on breastfeeding may reflect more general attitudes towards, and behaviour regarding, nutrition, the implication is that infants in Scotland may not be getting the best start in life, and this is resistant to change.

2 Purpose of review

This short review aims to describe what is known about maternal and infant nutrition at a population level in Scotland. It is designed to inform the maternal and infant nutrition strategy currently being developed by the Scottish Government.

To achieve this aim its objectives are:

- to detail the current availability of maternal and infant nutrition information in Scotland from national surveys, routinely collected data and robust ad hoc data sources
- to identify potential nutritional and dietary indicators that can be used to assess maternal and infant nutrient intake and nutritional status in Scotland
- to assess, where possible, using these indicators, maternal prenatal and postnatal diet and nutritional status, breastfeeding, weaning, and the diet and nutritional status of infants after weaning in Scotland.

3 Approach

The review is structured around key phases in pregnancy and infancy, from preconception up to the infant's third birthday. The age range of the infant (from birth to the third birthday) was based on that being used by the Scottish Government in the development of its maternal and infant nutrition strategy. The review is a compilation of existing published information: no new data collection was undertaken. We obtained some secondary analysis of data from Information Services Division Scotland (ISD Scotland), the Infant Feeding Survey, Growing Up in Scotland and the Scottish Health Survey.

We sought relevant data from routine sources, including regularly conducted surveys, in Scotland. Where these were not available, we sought one-off nationally representative surveys in Scotland or the UK. (Most nutritional studies within the UK focus on the UK as a whole, and the Scottish samples within these may not be adequately representative.) We excluded all non-UK studies on the basis of limited generalisability because of substantial differences in diet.

Key publications and data resources were identified in several ways:

- a literature search was conducted of published data on nutrition in women of childbearing age and during pregnancy, and maternal and infant nutrition following the birth and up to the infant's third birthday
- public health nutritionists involved with the maternal and infant nutrition strategy offered advice on key publications and studies of interest
- relevant data collected within NHS Scotland were identified and accessed from ISD Scotland
- resources such as the Centre for Longitudinal Studies and other relevant organisation and study websites were scanned for relevant material.

The literature search was performed with help from staff at the NHS Health Scotland library. The databases searched were Cochrane library, DARE, CINAHL, EMBASE, MEDLINE, MIDIRS and PsycINFO. The key search terms used were *preconception*, *infant(s)*, *nutrition*, *pregnancy*, *breastfeeding*, *weaning*, *Scotland*, *folate*, *folic acid*, *iron*, *calcium* and *vitamin D*. The full list of search terms is available on request from the author. Articles published in scientific journals were identified if the study was published from 1999 onwards, with recent studies (those published from 2004 onwards) preferred over earlier studies as these were more likely to represent current trends in diet.

How nutrient intake and nutritional status is assessed

The review assessed the data available on nutrient intake and nutritional status of some of the key vitamins and minerals important in women in Scotland of childbearing age, during pregnancy, following birth, and in infants up to their third birthday.

Nutrient intake

Nutrient intake provides information on the amount of a particular micronutrient consumed in the diet, or from a combination of diet and supplementation. It is usually collected by a dietary assessment method using estimates of the micronutrient content of foods to derive the amount taken.

Intake of each micronutrient was compared with the UK dietary reference values as defined by the Committee on Medical Aspects of Food (COMA) and, more recently, the Scientific Advisory Committee on Nutrition (SACN), which has replaced COMA.[8,9] These reference values represent the intake required to maintain good health in different populations. Throughout this review we have focused on the reference nutrient intake (RNI) and lower reference nutrient intake (LRNI) of each nutrient.

Reference nutrient intake (RNI)

The RNI is the intake of a nutrient that is considered to be sufficient to meet the needs of 97.5% of the general population.[9]

Lower reference nutrient intake (LRNI)

The LRNI is the intake of a nutrient that is enough for only 2.5% of the general population. Most people in the general population require more than the LRNI in order to remain healthy, and this measurement is often used to identify deficiencies in nutrients.[9]

Nutritional indicators included in the review

Based on advice from public health nutritionists, this review focused on vitamin D, folate, iron and calcium as important nutritional indicators.

Vitamin D

Vitamin D is required to aid absorption of calcium and phosphorus, both of which are required for bone growth and repair. Low levels are linked to bone conditions such as rickets and osteomalacia. Several recent studies have shown an association between vitamin D insufficiency and a number of other common diseases, although the role of vitamin D remains unclear.[10] The main source of vitamin D is through the action of sunlight on the skin. However, populations living in more northern latitudes, including Scotland, typically have lower levels of vitamin D as a result of reduced exposure to sunlight, especially during winter months.[11] Relatively small amounts of vitamin D come from foods such as oil-rich fish, eggs, and fortified cereals and margarine. Intake can also be increased by taking supplements.[12]

Folate

Folate is a B vitamin which works together with vitamin B_{12} to form healthy red blood cells. Folate deficiency increases the risk of having a baby with a neural tube defect (NTD). Folic acid, the synthesised form of folate, can be taken as a supplement to increase intake. It is recommended that women who may become pregnant and women in the first 12 weeks of pregnancy take a daily folic acid supplement containing 400 micrograms (µg). In addition to this, women are advised to eat foods rich in folate and folic acid to increase their nutrient intake to 300 µg/day for the duration of their pregnancy.[9,13,14] However, not all publicly available documents reflect this current guidance.[15] SACN estimated that around 700–900

pregnancies were affected by NTDs each year in the UK. Folate can be found in green leafy vegetables, such as broccoli, peas and chickpeas, and in some fruits.[12] Foods rich in folic acid include fortified breakfast cereals and yeast extract.[16]

Mandatory fortification of bread or flour with folic acid to increase the intake in women of childbearing age is currently under consideration in the UK.[17]

Iron

Iron is involved in the production of red blood cells. Iron is a mineral found in liver, meat, beans, nuts, dried fruit, whole grains, most dark leafy vegetables and fortified cereals.[12]

Calcium

Calcium is involved in the development of strong teeth and bones, regulating muscle contractions and blood clotting. This mineral can be found in dairy products, green leafy vegetables, soya products, nuts, fortified bread and oil-rich fish.[12,18]

Nutritional status

Nutritional status assesses how well nourished an individual or population group is by using appropriate measurements. For example, assessing body composition from measures of body fat and lean tissue, or measuring levels of nutrients in the body (e.g. iron stores indicated by serum ferritin). Therefore, the assessment of nutritional status may rely on the existence of an appropriate indicator for the nutrient(s) in question [e.g. plasma 25-hydroxyvitamin D (25-OHD) for vitamin D], and a reference value against which to compare the sample. Some of the limitations of nutritional status methodology are that few nutrients have a validated indicator, that there may not be clear consensus about which indicator to use and that reference values and cut-offs used for comparisons can vary between studies. In particular, measuring and interpreting the nutritional status of calcium is complex and there is no routine method of measuring the nutritional status of calcium from blood samples alone. Therefore, no results are reported on the nutritional status of calcium in women or infants.[18]

Other indicators

Breastfeeding, formula feeding, weaning, general diet, obesity and birthweight were also included as relevant indicators of nutrition.

What information is available

Table 3.1 summarises the available sources of data on maternal and infant nutrition in Scotland. It shows where there are gaps that have been filled, for this review, by data from studies in England. It also shows the gaps that cannot be filled from any source in Scotland or the UK.

More information on the sources used is given in Appendix A. We would caution that some sources used within this review are not recent and that some have small samples which are not adequately representative of the Scottish population.

Table 3.1 **Sources of data on maternal and infant nutrition in Scotland**

	Vitamin D	Folate	Iron	Calcium	General diet	Obesity	Weight of infant	Method of feeding	Introducing solid foods
Women of childbearing age	LIDNS NDNS(a)	LIDNS NDNS(a) SWS	LIDNS NDNS(a) SHeS (1998 only)	LIDNS NDNS(a)	SHeS	SHeS	n/a	n/a	n/a
Maternal nutrition during pregnancy	IFS ACS SWS	IFS ISD (NTDs) ACS SWS	IFS ACS ALSPAC	ACS SWS	SHeS ACS SWS	ISD	n/a	n/a	n/a
Maternal nutrition following the birth							n/a	n/a	n/a
Infant nutrition (prior to weaning)	ALSPAC	ISD (NTDs)	ALSPAC	ALSPAC		n/a	ISD	ISD GUS IFS SWS ALSPAC	n/a
Infant nutrition (following introduction of solid foods up to third birthday)	NDNS(b)	NDNS(b)	NDNS(b) ALSPAC	NDNS(b)	SHeS GUS ALSPAC SWS	n/a		n/a	IFS GUS SWS

Available for Scottish population | Available for English population | No information available

ACS	Diet and deprivation in pregnancy (Aberdeen cohort study) Data collection: pregnant women from 2000 to 2006
ALSPAC	Avon Longitudinal Study of Parents and Children Data collection: related to births in April 1991 to December 1992
GUS	Growing Up in Scotland Data collection: interviews every year from 2005/06 onwards
IFS	Infant Feeding Survey Data collection: every 5 years from 1975 to 2005
ISD	Information Services Division Scotland Data collection: continuous data collection from NHS Scotland

LIDNS	Low Income Diet and Nutrition Survey Data collection: November 2003 to January 2005
NDNS	National Diet and Nutrition Surveys: (a) those aged 19–64 years (adults) and (b) those aged 1½–4½ years (infants) Data collection: (a) July 2000 to June 2001 and (b) July 1992 to June 1993
SHeS	Scottish Health Survey Data collection: 1995, 1998, 2003, 2008
SWS	Southampton Women's Study Data collection: April 1998 to October 2002

4 Findings: maternal nutrition

One of the aims of this review was to assess the information available on the nutrition of women during pregnancy in Scotland. There is no routine information collected on the nutrition of pregnant women in Scotland or the UK, and most nutritional surveys exclude pregnant women. However, evidence from the Southampton Women's Survey (SWS) found little overall change in the dietary patterns of women before and during pregnancy.[19] This suggests that examining the diet of women of childbearing age can provide a reasonable indication of the diet of women during pregnancy. Women of 'childbearing age' were identified as those aged 15–44 years, based on the age of women giving birth in Scotland in 2008. Over 99% of births in Scotland were to women in this age range. Therefore, in order to obtain an indication of the diet of women during pregnancy, we have reported information on the diet of women aged 15–44 years in Scotland where possible.

This review does not provide detailed information on the general diet or obesity levels of women of childbearing age in Scotland. Although many micronutrients are important, following consultation with public health nutritionists, we have summarised the general diet and obesity and focused on vitamin D, folate, iron and calcium.

The two main nutritional surveys used throughout this review are the National Diet and Nutrition Survey (NDNS) and the Low Income Diet and Nutrition Survey (LIDNS). Both provide detailed information on nutrient intake and nutritional status of the UK population, including Scotland. However, the sample size for Scotland is too small to provide adequately representative data for the whole population, so results should be treated with caution. Results tables from the NDNS provide intake from 'all sources' and 'food sources only' for each micronutrient, the difference being that 'all sources' includes intake from diet and supplementation.

All rates used in this review are rounded to the nearest whole integer.

Women of childbearing age

For this section we sought data on general diet, obesity, nutrient intake and nutritional status of vitamin D, folate, iron and calcium in women of childbearing age in Scotland and the UK.

Dietary surveillance projects commissioned by the Food Standards Agency Scotland (FSAS) and the Scottish Health Survey (SHeS) have been used to provide summary information on the general diet in Scotland. We were unable to identify any Scottish studies providing robust measurement of nutrient intake and nutritional status of women of childbearing age. However, two UK surveys including a Scottish sample were identified (NDNS and LIDNS) and results are presented for both Scotland and the UK. The Scottish sample sizes were too small to be adequately representative of the Scottish population as a whole and cannot be directly compared with results for the UK sample. The NDNS and LIDNS assessed nutrient intake by analysing respondents' diets over a set time period and

assessed nutrient status by analysing blood samples where possible. Results have also been included from the SWS.

General diet

Scotland has a longstanding recognition of the need to tackle poor diet and obesity of the whole population, and this led to the publication of the Scottish Diet Action Plan.[5] The action plan contained a set of Scottish dietary targets which comprise population-level nutrient and food-based targets, initially set for achievement in 2005 and now extended to beyond 2010 as dietary goals.[20]

A recent review of progress towards the Scottish dietary targets and Food Standards Agency (FSA) targets indicated that there has been little change in the overall diet of the population in Scotland since 2001; only very small improvements were made towards achieving targets for the intake of fruit and vegetables, brown/wholemeal bread and oil-rich fish between 2001 and 2006, and there was no reduction in the intake of fat, saturated fat and added sugar, all of which remained considerably higher than the targets.[21]

The SHeS collects information on the intake of a limited number of foods, including fruit and vegetables. It collected information on the percentage of women meeting the recommended intake of five portions of fruit and vegetables per day in 2003 and 2008. In 2008, only 21% of women aged 16–44 years in Scotland consumed the recommended intake of five portions of fruit and vegetables in the day before their interview.[22] A total of 70% consumed between one and four portions of fruit and vegetables a day. There has been a small decrease in the proportion consuming none at all (12% in 2003 to 9% in 2008). Fruit and vegetable consumption was higher in older childbearing age groups (2.9 portions per day at age 16–24 years compared with 3.3 at age 25–34 and 35–44 years).

Deprived households in Scotland continue to have a poorer quality diet. Deprived households consume significantly less fruit and vegetables [172 grams (g) per person per day for the most deprived quintile vs. 292 g for the least deprived quintile], brown/wholemeal bread (11.5 g vs. 20.3 g), high-fibre breakfast cereals (6.7 g vs. 14.3 g) and oil-rich fish (20.1 g vs. 41.8 g) than affluent households.[21] Increasing deprivation, decreasing income and decreasing social class have also been linked to more energy-dense eating patterns in Scotland.[23] Such differences in food consumption may contribute to obesity and lower intakes of omega-3 fatty acids, dietary fibre and vitamins and minerals in women of childbearing age in deprived households compared with more affluent households. These trends in Scotland were similar to those found for the UK in low-income groups.[24]

Analysis of data from the SHeS also suggested that younger adults in Scotland were more likely to have a poorer-quality diet. Indeed, based on NDNS, the Scientific Advisory Committee on Nutrition (SACN) identified adolescent girls and young women in the UK as one of the groups most at risk of poor dietary variety and low nutrient intake and nutrient status.[24,25]

Obesity

This review does not provide detailed information on obesity levels of women of childbearing age in Scotland. However, as obesity at time of conception is known to increase the risk of many conditions during pregnancy, we have looked at obesity levels in women of childbearing age in Scotland.

The relationship between height and weight can be used to calculate a body mass index (BMI) by dividing an individual's weight in kilograms by their height in metres squared (kg/m^2). Individuals are defined as being overweight if they have a BMI of 25–29 kg/m^2 and obese if they have a BMI of 30 kg/m^2 or above.[20]

The SHeS 2008 found that 52% of women aged 16–44 years were overweight or obese. There has been a steady increase in the proportion of women aged 16–64 years who were overweight or obese, from 47% in 1995 to 60% in 2008.[22]

Vitamin D

Nutrient intake

The main source of vitamin D is through the action of sunlight on the skin. However, populations living in more northern latitudes, including Scotland, receive lower levels of vitamin D through this process and therefore have to enhance their intake through a combination of diet and supplements (see 3.1.2).[11]

There is no reference nutrient intake (RNI) or lower reference nutrient intake (LRNI) set for vitamin D for women of childbearing age who are not pregnant or breastfeeding.

The NDNS and LIDNS provided information on vitamin D intake from food sources (Table 4.1). Median intake of vitamin D from food sources ranged from 1.8 to 2.3 micrograms per day (µg/day) for women in the UK.

Vitamin D intake from all sources, including supplementary intake, was reported in the NDNS only (Table 4.2). Supplementation made only a small difference to total intake.

Table 4.1 **Vitamin D intake in women from food sources *only*, 2000–2001 and 2003–2005**

Survey	Year	Area	Age range (years)	Median daily intake (µg)
NDNS	2000–2001	UK	19–24	1.8
		UK	19–64	2.3
		Scotland	19–64	2.4
LIDNS	2003–2005	UK	19–34	1.9
		UK	19–64	2.0
		Scotland	19–64	2.3

Source: NDNS and LIDNS. See Appendix B.

Table 4.2 **Vitamin D intake in women from *all* sources, 2000–2001**

Survey	Year	Area	Age range (years)	Median daily intake (µg)
NDNS	2000–2001	UK	19–24	2.1
		UK	19–64	2.7
		Scotland	19–64	2.4

Source: NDNS. See Appendix B.

Nutritional status

Vitamin D status was assessed in the NDNS and LIDNS by measuring levels of plasma 25-hydroxyvitamin D (25-OHD) in blood samples. A threshold of 25 nanomoles per litre (nmol/l) of 25-OHD was used to define deficiency.[24,26]

A high proportion of UK women aged 19–24 had median concentration of 25-OHD below the threshold in both the NDNS and LIDNS (Table 4.3). Although there is limited information on vitamin D status in Scottish women, it is likely that they have poorer status than women in the UK as a whole owing to the more northern latitude. The SACN has reported a need for standardisation of laboratory methods used to assess vitamin D status.[11] Direct comparison between the NDNS and LIDNS is not recommended because of the potential effect of differences in the methods used.

Table 4.3 **Vitamin D status in women, 2000–2001 and 2003–2005**

Survey	Year	Area	Age range (years)	Median 25-OHD concentration (nmol/l)	Women below deficiency threshold (%)
NDNS	2000–2001	UK	19–24	39.3	28
		UK	19–64	46.5	15
		Scotland	19–64	35.3	–
LIDNS	2003–2005	UK	19–34	44.0	19
		UK	19–64	42.0	17
		Scotland	19–64	34.3	35

Source: NDNS and LIDNS. See Appendix B.

– not reported at Scottish level.

Folate

Nutrient intake

The RNI for folate for women aged 15 years and over is 200 µg/day, and the LRNI is 100 µg/day. However, the Department of Health (DoH) recommends that women who are trying to conceive or are in the early stages of pregnancy take a daily supplement containing 400 micrograms (µg) of folic acid to decrease the risk of having a baby with a neural tube defect (NTD). In addition to this, women are advised to increase their intake of foods rich in folate and folic acid to 300 µg/day for the duration of the entire pregnancy.[9]

The NDNS and LIDNS provided information on folate intake from food sources (Table 4.4). Although folate nutrient intake was adequate for most women in both the NDNS and LIDNS, it was still much lower than the recommended intake for women planning pregnancy and tended to be lower in younger women. The higher proportion of women below the LRNI for folate in the LIDNS compared with women in the NDNS suggests that deprived populations have poorer intake.

Table 4.4 **Folate intake in women from food sources *only*, 2000–2001 and 2003–2005**

Survey	Year	Area	Age range (years)	Median daily intake (µg)	Median (% RNI)	Percentage of recommended total intake during pregnancy*	Women below LRNI (%)
NDNS	2000–2001	UK	19–24	225	112	75	3
		UK	19–64	245	122	82	2
		Scotland	19–64	229	114	76	2
LIDNS	2003–2005	UK	19–34	184	92	61	6
		UK	19–64	195	98	65	7
		Scotland	19–64	183	91	61	6

Source: NDNS and LIDNS. See Appendix B.

*For preconception and first 12 weeks of pregnancy.

Folate intake from all sources including supplementary intake was reported in the NDNS only (Table 4.5). Dietary supplements increased folate intake in women in the UK to 255 µg/day (an increase of 4%).

Folate intake was found to increase with age in women in the UK. The proportion of women reported to have an intake below the recommendation for women intending to conceive varied with age, but in all age groups very few women of childbearing age took sufficient folate.

Table 4.5 **Folate intake in women from *all* sources, 2000–2001**

Survey	Year	Area	Age range (years)	Median daily intake (µg)	Median (% RNI)	Percentage of recommended total intake during pregnancy*	Women below LRNI (%)
NDNS	2000–2001	UK	19–24	232	116	33	3
		UK	19–64	255	128	36	2
		Scotland	19–64	229	114	33	2

Source: NDNS. See Appendix B.

*For preconception and first 12 weeks of pregnancy.

Nutritional status

Folate status was assessed in both the NDNS and LIDNS by measuring the concentration of slightly different components in the blood. The surveys used different thresholds to indicate folate deficiency. The NDNS used a threshold of 6.3 nmol/l folate in serum and the LIDNS used a threshold of 7.0 nmol/l folate in plasma. The NDNS used a threshold of 337 nmol/l red cell folate to define deficiency, whereas the LIDNS used a threshold of 350 nmol/l.[24,26]

SACN recommended in 2006 that a standard analytical method be applied for measuring folate status in nutritional surveys. The suitability of each of the methods employed was subsequently assessed and a standard method proposed by the FSA for future surveys.[14,27]

The NDNS provided information on folate status by measuring the concentration of folate in serum and red blood cells (Tables 4.6 and 4.7), whereas the LIDNS measured the concentration of folate in plasma rather than serum (Table 4.8 and 4.9). Folate in plasma (or serum) reflects recent intake, whereas red blood cell folate reflects long-term intake.

The NDNS did not report the proportion of Scottish women with serum folate or red cell folate concentration below the threshold.

Table 4.6 **Serum folate concentration in women, 2000–2001**

Survey	Year	Area	Age range (years)	Threshold to indicate deficiency (nmol/l)	Median folate in serum concentration (nmol/l)	Women below threshold (%)
NDNS	2000–2001	UK	19–24	6.3	19.7	0
		UK	19–64	6.3	21.0	<0.5
		Scotland	19–64	6.3	18.1	–

Source: NDNS. See Appendix B.

– not reported at Scotland level.

Table 4.7 **Red cell folate concentration in women, 2000–2001**

Survey	Year	Area	Age range (years)	Threshold to indicate deficiency (nmol/l)	Median concentration of red cell folate (nmol/l)	Women below threshold (%)
NDNS	2000–2001	UK	19–24	337	526	8
		UK	19–64	337	610	5
		Scotland	19–64	337	574	–

Source: NDNS. See Appendix B.

– not reported at Scotland level.

Over 10% of women in the UK were below the lower threshold for concentration of plasma folate and also for red cell folate (Tables 4.8 and 4.9). The median concentration of plasma folate in women aged 19–64 years was 15.8 nmol/l. Direct comparisons between results from the NDNS and LIDNS are not recommended because of the differences in the methods used to analyse folate status.

Table 4.8 **Plasma folate concentration in women from low-income households, 2003–2005**

Survey	Year	Area	Age range (years)	Threshold to indicate deficiency (nmol/l)	Median folate in serum concentration (nmol/l)	Women below threshold (%)
LIDNS	2003–2005	UK	19–34	7.0	15.3	12
		UK	19–64	7.0	15.8	13
		Scotland	19–64	7.0	13.1	14

Source: LIDNS. See Appendix B.

Table 4.9 **Red cell folate concentration in women from low-income households, 2003–2005**

Survey	Year	Area	Age range (years)	Threshold to indicate deficiency (nmol/l)	Median concentration of red cell folate (nmol/l)	Women below threshold (%)
LIDNS	2003–2005	UK	19–34	350	606	12
		UK	19–64	350	635	13
		Scotland	19–64	350	699	10

Source: LIDNS. See Appendix B.

A study based on data from the SWS assessed folic acid intake in 12,583 non-pregnant women aged 20–34 years. The women were followed up to compare folic acid intake in those who became pregnant within three months of recruitment with those who did not become pregnant. Just under one-half (44%) of women took any folic acid supplements in the three months before becoming pregnant, and only 6% took the recommended 400 µg/day of folic acid supplements.[3]

Iron

Nutrient intake

The RNI for iron in women aged 19–50 years is 14.8 milligrams per day (mg/day), and the LRNI is 8.0 mg/day. Women of childbearing age should ensure that they have sufficient iron stores before conceiving as it has been estimated that 680 mg of iron are required for the products of conception.[9] Physiological adaptations during pregnancy, such as the cessation of menstruation and an increase in iron absorption, help to conserve iron but if iron stores are low at the point of conception then the mother may risk becoming anaemic during the pregnancy.

The NDNS and LIDNS provided information on iron intake from food sources (Table 4.10). Iron intake from all sources, including supplementary intake, was reported in the NDNS only (Table 4.11).

The median intake of iron from food sources in women aged 19–64 in the UK was 9.6 mg/day; a greater proportion of younger women had low intake. The proportion of Scottish women below the LRNI was not reported in the NDNS from food sources. The higher proportion of women below the LRNI for iron in the LIDNS compared with women in the NDNS suggests that deprived populations may have poorer intake.

Table 4.10 **Iron intake in women from food sources *only*, 2000–2001 and 2003–2005**

Survey	Year	Area	Age range (years)	Median daily intake from food sources only (mg)	Median (% RNI)	Women below LRNI (%)
NDNS	2000–2001	UK	19–24	9.1	61	42
		UK	19–64	9.6	65	25
		Scotland	19–64	10.5	71	–
LIDNS	2003–2005	UK	19–34	8.0	54	49
		UK	19–64	8.2	55	30
		Scotland	19–64	11.0	74	28

Source: NDNS and LIDNS. See Appendix B.

– not reported at Scotland level.

Iron intake from all sources was slightly higher than from food sources only in both the UK and Scottish samples. The median intake of iron from all sources in women aged 19–64 in the UK was 10.0 mg/day.

Table 4.11 **Iron intake in women from *all* sources, 2000–2001**

Survey	Year	Area	Age range (years)	Median daily intake from all sources (mg)	Median (% RNI)	Women below LRNI (%)
NDNS	2000–2001	UK	19–24	9.3	63	40
		UK	19–64	10.0	68	24
		Scotland	19–64	10.8	73	–

Source: NDNS. See Appendix B.

– not reported at Scotland level.

Nutritional status

Iron status was assessed in the NDNS and LIDNS by measuring the concentration of different components in the blood. Both looked at haemoglobin levels and serum ferritin to assess iron status in participants. A threshold of 12 grams per decilitre (g/dl) of haemoglobin and 15 micrograms per litre (µg/l) serum ferritin was used to identify iron deficiency in women.[24,26]

The NDNS and LIDNS provided information on iron status by measuring the concentration of haemoglobin (Table 4.12) and serum ferritin levels (Table 4.13) in women in the UK.

The LIDNS showed the highest levels of iron deficiency in the younger age groups of women in the UK. Iron deficiency identified by serum ferritin levels decreased with age, from 21% of women aged 19–34 years to 14% of women aged 35–49 years being below the deficiency threshold. However, haemoglobin deficiency levels increased with age, from 12% for those aged 19–34 years to 18% for those aged 35–49 years. The higher proportion of women below the LRNI for both haemoglobin and serum ferritin in the LIDNS compared with women in the NDNS suggests that deprived populations have poorer intake.

Table 4.12 **Haemoglobin levels in women, 2000–2001 and 2003–2005**

Survey	Year	Area	Age range (years)	Median haemoglobin levels (µg/l)	Women below threshold (%)
NDNS	2000 to 2001	UK	19–24	13.7	7
		UK	19–64	13.4	8
		Scotland	19–64	13.8	–
LIDNS	2003 to 2005	UK	19–34	13.5	12
		UK	19–64	13.5	12
		Scotland	19–64	13.7	6

Source: NDNS and LIDNS. See Appendix B.

– not reported at Scotland level.

Table 4.13 **Serum ferritin levels in women, 2000–2001 and 2003–2005**

Survey	Year	Area	Age range (years)	Median serum ferritin levels (µg/l)	Women below threshold (%)
NDNS	2000–2001	UK	19–24	34	16
		UK	19–64	40	11
		Scotland	19–64	28	–
LIDNS	2003–2005	UK	19–34	29	21
		UK	19–64	48	11
		Scotland	19–64	49	6

Source: NDNS and LIDNS. See Appendix B.

– not reported at Scotland level.

The 1998 SHeS measured haemoglobin levels and serum ferritin levels to assess iron deficiency in participants. The survey reported that 8% of women (aged 16 and over) in the survey had an iron deficiency with haemoglobin levels below 12 g/dl. A higher proportion of women in the 35–44-year-old age group had an iron deficiency (12%) than in the 16–24-year-old age group (7%). Mean serum ferritin levels in women were 35.8 µg/l and were higher in the older age groups.[28]

Calcium

Nutrient intake

The RNI for calcium for women aged 15–18 years is 800 mg/day and for women aged 19–50 years is 700 mg/day. The LRNI for women aged 15–18 years is 480 mg/day and for women aged 19–50 years is 400 mg/day.[9]

The NDNS and LIDNS provided detailed information on calcium intake from food sources (Table 4.14). The higher proportion of women below the LRNI for calcium in the LIDNS (11%) compared with women in the NDNS (5%) suggests that deprived populations have poorer intake.

Table 4.14 **Calcium intake in women from food sources *only*, 2000–2001 and 2003–2005**

Survey	Year	Area	Age range (years)	Median daily intake (mg)	Median (% RNI)	Women below LRNI (%)
NDNS	2000–2001	UK	19–24	661	94	8
		UK	19–64	752	107	5
		Scotland	19–64	707	101	3
LIDNS	2003–2005	UK	19–34	628	90	15
		UK	19–64	669	96	11
		Scotland	19–64	644	92	7

Source: NDNS and LIDNS. See Appendix B.

Calcium intake from all sources was reported in the NDNS only (Table 4.15), and supplementation made little difference to total intake.

Table 4.15 **Calcium intake in women from *all* sources, 2000–2001**

Survey	Year	Area	Age range (years)	Median daily intake (mg)	Median (% RNI)	Women below LRNI (%)
NDNS	2000–2001	UK	19–24	669	94	8
		UK	19–64	763	109	5
		Scotland	19–64	707	101	3

Source: NDNS. See Appendix B.

Nutritional status

Measuring and interpreting the nutritional status of calcium is complex, and there is no routine method for measuring the nutritional status of calcium from blood samples alone.

We were unable to identify any large-scale studies assessing the nutritional status of calcium in women of childbearing age in Scotland or the UK.

Maternal nutrition during pregnancy

For this section we sought data on general diet, maternal obesity, nutrient intake and nutritional status of vitamin D, folate, iron and calcium in women during pregnancy in Scotland and the UK.

Information from a recent prospective cohort study of 1,461 pregnant women in Aberdeen, Scotland, which provided information on nutrient intake, supplement use and pregnancy outcome for women recruited between 2000 and 2006, has also been included.[29] This study involved women completing a food frequency questionnaire at 19 weeks' gestation to assess diet and nutrient intake during pregnancy.

This was the only recent Scottish study providing robust measurement of nutrient intake or nutritional status of women during pregnancy, and we were unable to identify any other large-scale Scottish studies. However, data have also been included from the SHeS, Infant Feeding Survey (IFS), Information Services Division Scotland (ISD Scotland) and the SWS.

General diet

General advice for maintaining a healthy diet and body weight should continue to be followed by women during pregnancy. In addition, women in the UK are advised during pregnancy to consume at least five portions of fruit and vegetables per day, consume less than 300 mg of caffeine per day, avoid eating marlin, shark and swordfish, limit the amount of tuna eaten and avoid alcohol altogether, or at the very least to limit their intake to 1–2 units once or twice a week. Further details can be found on the FSA website.[30]

The Aberdeen cohort study assessed diet and nutrient intake during pregnancy in 1,461 women. In general, poor food choices were consistent with poor nutrient intake, and there was a strong social gradient across deciles of the Scottish Index of Multiple Deprivation (SIMD).[29,31] The study has presented results only by SIMD decile and not for the cohort overall. The more deprived women had lower intakes of fruit and vegetables and oil-rich fish and higher intakes of processed meat, fried potatoes, crisps and snacks, milk and cream and soft drinks than the least deprived. The nutrient intake of the most deprived women was lower in protein, non-starch polysaccharides and most vitamins and minerals.

We were unable to identify any other large-scale studies on general diet during pregnancy in Scotland. The SHeS included a very small number of pregnant women, but too few to provide robust information.

The SWS looked at 1,490 women who gave birth between 1998 and 2003 and assessed their diet before pregnancy, at 11 weeks' gestation and at 34 weeks' gestation. There was little change in fruit and vegetable intake before and during pregnancy, with 47% of women not consuming five a day before pregnancy compared with 46% at week 11 of their pregnancy.[32] Alcohol consumption decreased substantially, from 54% consuming more than four units of alcohol per week before becoming pregnant to 10% consuming the same amount at 11 weeks' gestation. Similarly, 39% consumed more than 300 mg of caffeine per day before pregnancy compared with just 16% at 11 weeks. Another study using data from the SWS found little overall change in dietary patterns in women from before and during pregnancy when comparing 48 different food groups.[19]

Maternal obesity

This review does not provide detailed information on obesity levels of women during pregnancy in Scotland. However, as obesity during pregnancy is known to increase the risk of many conditions during pregnancy, we sought information on obesity levels in women during pregnancy in Scotland.

Obesity at first booking (the first appointment with a midwife during their pregnancy) is considered to be another form of maternal malnutrition, with such women having an increased risk of developing type 2 diabetes, impaired glucose tolerance and gestational diabetes mellitus during pregnancy.[33,34] Obese women also have higher rates of induction of labour, caesarean section and postpartum haemorrhage.[35] Obesity during pregnancy also has adverse effects on the developing infant and increases the level of fat in the infant, the risk of stillbirth, congenital abnormalities, premature birth and neonatal death, and results in heavier babies.[1,33]

Data are collected on the mother's height and weight at her first appointment with a midwife. Work is currently under way in ISD Scotland to assess whether data on maternal height and weight are of sufficient quality to provide information on the level of maternal obesity in Scotland and its association with birthweight. This would provide a very useful and important indicator of maternal health.

Vitamin D

Nutrient intake

The DoH recommends that during pregnancy women should take a daily vitamin D supplement containing 10 µg.[9]

We identified one large-scale study on vitamin D intake during pregnancy in Scotland. The Aberdeen cohort study assessed diet and nutrient intake during pregnancy in 1,461 women.[29] The study presented results only by SIMD decile and not for the cohort overall. It did not report significant differences in vitamin D intake across deciles of SIMD.

We were unable to identify any other large-scale studies on vitamin D intake in women during pregnancy in Scotland.

The IFS did not specifically ask about vitamin D intake, but it found that only 6% of women in Scotland participating in the survey had taken any type of supplement during their pregnancy (7% in the whole of the UK). Only 1% of the mothers in Scotland had taken 'other' supplements which did not include iron or vitamins during their pregnancy, the same percentage as in the UK.[36]

Nutritional status

There is no standard threshold used to assess vitamin D status in women during pregnancy, although similar measures have been used in some studies as those for women of childbearing age.

We were unable to identify any large-scale studies on vitamin D status during pregnancy in Scotland.

A study in Southampton followed 198 infants born in 1991–1992 to assess the effect of vitamin D intake during pregnancy. Nearly one-half of mothers had low levels of 25-OHD in late pregnancy: 31% had insufficient (11–20 µg/l) and 18% had deficient (<11 µg/l) levels.[37]

Folate

Nutrient intake

Women are advised to increase their folate intake to 300 µg/day for the duration of their pregnancy by eating foods rich in folate and folic acid. In addition to this, the DoH recommends that most women should take 400 µg/day of folic acid supplements before conception and until the 12th week of pregnancy. Women who have had a previous pregnancy affected by an NTD, have an NTD themselves, have a partner with an NTD, are taking medication for epilepsy, have a condition caused by sensitivity to gluten (coeliac disease) or have diabetes should take 5 mg/day of folic acid as they are thought to be at increased risk of having an infant with an NTD.[9,38]

We identified one large-scale study on folate intake during pregnancy in Scotland. The Aberdeen cohort study assessed diet and nutrient intake during pregnancy in 1,461 women.[29] The study has presented results only by SIMD decile and not for the cohort overall. Between 40% and 50% of the least deprived women reported taking folic acid supplements before conception, but uptake was half as likely in the most deprived women. However, after conception and before the 12th week of pregnancy four out of five women reported taking folic acid supplementation by the 12th week of pregnancy, and this was irrespective of the level of deprivation. Folate status measured by blood sample at 19 weeks' gestation showed a strong social gradient, with the most deprived women having the lowest levels.

We were unable to identify any other large-scale studies on folate intake during pregnancy in Scotland.

Over three-quarters (77%) of women in the IFS in 2005 reported having taken folic acid supplements at some point in the first few months of pregnancy, similar to the whole of the UK (75%). One in three (31%) reported making changes to their diet in the first few months of pregnancy to increase folate intake when pregnant compared with 28% in the whole of the UK, although this is not consistent with findings from the SWS (containing a more robust dietary assessment) that diet changes little during pregnancy.[19]

However, taking a supplement cannot be assumed to mean that the recommended level of folate is being taken. The SWS assessed folic acid intake in 203 pregnant women aged 20–34 years of age at 11 weeks' gestation. Nearly all (93%) were taking some folic acid supplements, but only 12% were taking the recommended 400 µg a day of supplements.[3]

There was a general decrease in NTDs in Scotland, from 1.3 to 1.0 per 1,000 singleton births and abortions between 1997–1999 and 2005–2007.[i,39] Given the proven link between reduced risk of NTDs and increased intake of folate before conception and during early pregnancy, this might be indicative of an improvement in folate intake.[40] However, this is very indirect evidence of possible improved folate intake and cannot be assumed to be the case.

i NTDs in singleton births in Scotland detected at birth, during infancy or aborted because of prenatal diagnosis (ISD Scotland).

Nutritional status

There is no standard threshold to assess folate status in women during pregnancy, although similar measures can be used as those for women of childbearing age.

We identified one large-scale study on folate status during pregnancy in Scotland. The Aberdeen cohort study has presented results only by SIMD decile and not for the cohort overall. There was a strong social gradient in folate status in pregnant women at 19 weeks' gestation, with the poorest status in the most deprived groups. Highest levels of folate were found in the first 3–4 deciles, followed by a steep decline with increasing deprivation.[29]

We were unable to identify any other large-scale studies on folate status during pregnancy in Scotland or the UK.

Iron

There is an increased demand for iron during pregnancy for the increase in maternal tissue and the needs of the growing foetus. This is met by physiological adaptations which help to conserve iron for the pregnancy, such as the cessation of menstruation and an increase in iron absorption. Therefore, provided maternal iron stores are adequate at the onset of the pregnancy, there is no recommendation to increase nutrient intake over and above the RNI for non-pregnant women. Research on the effect of maternal anaemia on infant health is inconclusive.[9,41]

Nutrient intake

There is no requirement to increase iron intake during pregnancy, but women should still be meeting the RNI of 14.8 mg/day. Women of childbearing age should ensure that they have sufficient iron stores before conceiving as it has been estimated that 680 mg of iron is required for the products of conception.[9]

We identified one large-scale study on iron nutrient intake during pregnancy in Scotland. The Aberdeen cohort study has presented results only by SIMD decile and not for the cohort overall. The study found that iron intake was significantly lower in the most deprived pregnant women.[29]

We were unable to identify any other large-scale studies of iron nutrient intake during pregnancy in Scotland or the UK.

The IFS found that 29% of women in Scotland had taken iron supplements during their pregnancy, the same proportion as the whole of the UK. A total of 14% of the mothers in Scotland had taken iron supplements combined with other vitamins and minerals (excluding folic acid) during their pregnancy compared with 17% in the whole of the UK.[36]

Nutritional status

There is no standard threshold to assess iron status during pregnancy, although similar measures can be used as those for women of childbearing age.

We were unable to identify any large-scale studies of iron status during pregnancy in Scotland.

Calcium

There is an increased demand for calcium during pregnancy to meet the needs of the growing foetus. This is met by physiological adaptations during pregnancy, which increase the absorption of calcium, and through mobilisation of maternal body stores of calcium. Therefore, provided maternal calcium stores are adequate at the onset of pregnancy, there is no recommendation to increase nutrient intake over and above the RNI for non-pregnant women.

Nutrient intake

There is no requirement to increase calcium intake during pregnancy, but women should still be meeting the RNI of 800 mg/day for those aged 15–18 years and 700 mg/day for those aged 19–50 years.[9]

We identified one large-scale study on calcium intake in women during pregnancy in Scotland. The Aberdeen cohort study has presented results only by SIMD decile and not for the cohort overall. The study found no significant difference in calcium intake in pregnancy by deprivation category (using SIMD).[29]

We were unable to identify any other large-scale studies on calcium nutrient intake in women during pregnancy in Scotland.

There is an increased demand for calcium placed on the mother during pregnancy because of foetal development. During the third trimester of pregnancy, the foetus requires 250–300 mg of calcium per day.[42] Consistent with this, the SWS found that the developing foetus requires between 13 g and 33 g of calcium in total, with 80% of this required during the third trimester.[42] A reduction in width of the maternal heel bone during pregnancy resulted from calcium being absorbed by the foetus.[43] This was more likely in women consuming less than one pint of milk per day, suggesting a link with calcium intake during pregnancy.

Nutritional status

Measuring and interpreting the nutritional status of calcium is complex, and there is no routine method for measuring the nutritional status of calcium from blood samples alone.

We were unable to identify any large-scale studies assessing the nutritional status of calcium in women during pregnancy in Scotland or the UK.

Maternal nutrition following the birth

For this section we sought data on general diet, maternal weight following the birth, nutrient intake and nutritional status of vitamin D, iron and calcium in women following the birth in Scotland and the UK. As folate is mainly important before conception and during the first 12 weeks of pregnancy, we have not assessed folate intake or nutritional status in women after giving birth. We were unable to identify any Scottish or UK studies providing robust measurement of nutrient intake or nutrient status of women following the birth.

General diet

General advice for maintaining a healthy diet should continue to be followed by women following the birth of their infant.

We were unable to identify any large-scale studies of the general diet in women after giving birth in Scotland or the UK.

Maternal weight following the birth

Information on maternal weight following the birth is not routinely collected in Scotland. Although the opportunity to measure and record maternal weight is possible during routine appointments following the birth, there are currently no mandatory weight measurements recorded.

Vitamin D

Nutrient intake

Women who are breastfeeding should take a daily vitamin D supplement containing 10 µg.[11]

We were unable to identify any large-scale studies on vitamin D intake in women after giving birth in Scotland or the UK.

Nutritional status

There is no standard threshold to assess vitamin D status in women after giving birth, although similar measures can be used as those for women of childbearing age.

We were unable to identify any large-scale studies assessing vitamin D status in women after giving birth in Scotland or the UK.

Iron

Nutrient intake

The FSA advises women to eat plenty of iron-rich food after pregnancy as they could have become deficient during their pregnancy.[30]

We were unable to identify any large-scale studies on iron intake in women after giving birth in Scotland or the UK.

Nutritional status

There is no standard threshold to assess iron status in women after giving birth, although similar measures can be used as those for women of childbearing age.

We were unable to identify any large-scale studies assessing iron status in women after giving birth in Scotland or the UK.

Calcium

Nutrient intake

Women should increase their calcium intake to 1250 mg/day while breastfeeding.[9]

We were unable to identify any large-scale studies on calcium intake in women after giving birth in Scotland or the UK.

Nutritional status

Measuring and interpreting the nutritional status of calcium is complex and there is no routine method for measuring the nutritional status of calcium from blood samples alone.

We were unable to identify any large-scale studies assessing the nutritional status of calcium in women after giving birth in Scotland or the UK.

5 Findings: infant nutrition

One of the aims of this review was to assess the information available on the nutrition of infants in Scotland. Although routine and survey data are collected on breastfeeding and formula feeding in Scotland and the UK, there is limited information collected on the introduction of solids (commonly referred to as weaning). Unfortunately, there is also no routine information collected on the nutrition of infants after initiation of weaning in Scotland or the UK, and there are currently no regular or recent survey data available assessing nutrient intake or nutritional status.

Although there are no recent survey data available on the nutrient intake or nutritional status of infants in Scotland or the UK, results from a national survey in 1992 have been included in the following sections. The National Diet and Nutrition Survey: Infants aged 1½ to 4½ years [NDNS (1½ to 4½ years)] provided detailed information on nutrient intake of the UK population, including a Scottish sample. However, the sample size for Scotland is too small to provide adequately representative data for the whole population, so results should be treated with caution. Although this data source may be considered out of date because of changes in diet since 1992, we have included it as it contains the most recent detailed information available on nutrient intake in infants in the UK.

This review does not provide detailed information on the general diet or weight of infants in Scotland. Although many nutrients are important, following consultation with public health nutritionists we have focused on vitamin D, iron and calcium.

All rates used in this review are rounded to the nearest whole integer.

Infant nutrition prior to weaning

For this section we sought data from Scotland and the UK on birthweight of the infant, method of feeding, and nutrient intake and nutritional status of vitamin D, iron and calcium. We were unable to identify any Scottish studies providing robust measurement of nutrient intake or nutritional status in infants prior to the introduction of solid foods. In theory, intake of key nutrients could be calculated from consumption of breast milk and formula feeding, but this would require information on quantities consumed and composition in everyday use as fed to the infant, which is not routinely collected.

We have included data from the Infant Feeding Survey (IFS), Growing Up in Scotland (GUS) and Information Services Division Scotland (ISD Scotland) on feeding methods (both breastfeeding and formula feeding), breastfeeding initiation rates, breastfeeding duration and breastfeeding by deprivation and maternal age in Scotland.

Birthweight of infant

Although birthweight is particularly influenced by maternal weight at conception, it also reflects maternal nutrition during pregnancy and gives an indication of the nutrition received by the developing infant. Nutrition during pregnancy is thought to provide developing

infants with an insight into the level of nutrition they will receive when they are born. Poor nutrition in pregnancy during periods of rapid or critical foetal development is thought to result in permanent changes in the structure of organs in the developing infant, which can lead to problems in later life.[1] Problems are thought to occur when the postnatal diet differs drastically from the diet received during pregnancy. Therefore, an infant receiving poor levels of nutrition during pregnancy going on to receive a high-calorie diet following birth would be at greater risk of developing disease in later life.[1]

Low birthweight has been linked with chronic adult disease such as cardiovascular disease, raised blood pressure, insulin resistance and type 2 diabetes. There is also evidence to suggest that infants born with a low birthweight are more likely to become obese as adults.[1] Birthweight of infants born in Scotland is published by ISD Scotland. The proportion of full-term infants in Scotland with low birthweight has remained at a similar level since 1988 with under 3% having low birthweight [<2,500 grams (g)] and less than 0.05% having very low birthweight (<1,500 g).[44]

Evidence suggests that women born with low birthweight are at an increased risk of developing gestational diabetes (diabetes developed during pregnancy) if they become pregnant in the future. This risk is further increased if they become obese in adult life.[1] Both gestational diabetes and obesity may lead to pregnancies resulting in infants with increased birthweight. It is possible that the recent increase in levels of obesity in Scotland may be having an effect on birthweight. However, although data are collected on birthweight in Scotland, there are no current definitions of 'high' birthweight, and this is not routinely published. Therefore, we are currently unable to comment on the proportion of babies with higher birthweight in Scotland.

Method of feeding

Breastfeeding is recommended as the optimal method of feeding from birth. The Scottish Government advises that all infants should be exclusively breastfed from birth to around 6 months of age. It is recommended that breastfeeding should continue beyond 6 months, alongside the introduction of appropriate solid foods, for up to 2 years of age or as long as the mother chooses.

There is strong evidence of the health benefits of breast milk over formula milk. Babies who are breastfed are less likely to suffer from ear, respiratory, gastrointestinal and urinary tract infections, allergic disease (eczema, asthma and wheezing) and type 1 diabetes and are less likely to be overweight later in childhood. Women who have breastfed are at lower risk of breast and ovarian cancer, and there is some evidence to suggest that they are more likely to return to their pre-pregnancy weight. Breast milk contains a wide range of substances to support the development of the digestive and immune systems of the growing infant. These substances are not present in infant formula, and infants fed with formula are more likely to suffer from a range of infections as they do not receive the protective substances contained in breast milk (e.g. immunoglobulins, hormones, enzymes).[45,46] However, less than 35% of infants worldwide are exclusively breastfed for the first 4 months of life, and the rates are even lower in Scotland, with little improvement seen in recent years.[7,47]

The World Health Organization (WHO) defines 'exclusive breastfeeding' as giving no other food or drink – not even water – except breast milk. It does, however, allow the infant to receive drops and syrups such as vitamin and mineral supplements and medicines.[36] The

IFS uses this definition to report data on exclusive breastfeeding. 'Mixed breastfeeding' is defined as receiving both breast milk and formula milk or other milk.[48]

Breastfeeding data published by ISD Scotland provide only an indicator of 'exclusive breastfeeding' and do not match the WHO definition.[7] The mother is asked whether the infant is exclusively breastfed, exclusively formula fed or receiving mixed feeding (both breast and formula). In the past there has probably been some variation in how this question was asked. In order to improve consistency, recent guidance for public health nurses specifies the feeding method recorded on Child Health Systems Programme – Pre-School (CHSP-PS) system should relate to the type of feeding **in the last 24 hours**. The data are presented here with the caution that they may slightly misreport the level of exclusive breastfeeding.

Breastfeeding

Incidence of breastfeeding

Initiation of breastfeeding is seen as one of the most important stages in trying to improve breastfeeding rates. If breastfeeding is not started within a day or two following the birth it is unlikely to start at all. The incidence of breastfeeding refers to the proportion of babies who were initially breastfed. The prevalence of breastfeeding refers to the proportion of babies wholly or partially breastfed at specific ages.[36]

Survey data

The IFS is conducted every five years in the UK and assesses the feeding methods of infants from birth to the age of 9–12 months. In 2005, the incidence of breastfeeding was 70% in Scotland, with a strong rise since 1990 (Table 5.1; Figure 5.1); other UK countries have also shown increases. Breastfeeding is more common in mothers with higher educational levels, those aged 30 or over, first-time mothers and those from managerial and professional occupations.

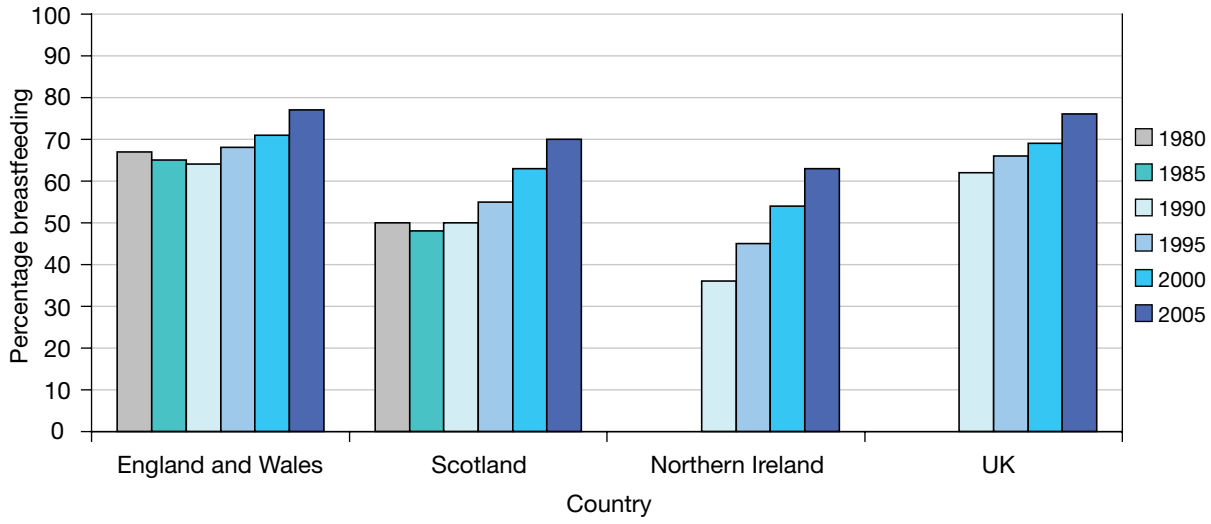
Table 5.1 **Incidence of breastfeeding initiation (% of mothers breastfeeding) by UK country, 1980 to 2005**

	1980	1985	1990	1995	2000	2005
Scotland	50	48	50	55	63	70
England and Wales	67	65	64	68	71	77
Northern Ireland	–	–	36	45	54	63
UK	–	–	62	66	69	76

Source: IFS – Stage 1 mothers (infants aged 4–10 weeks).

– data not collected at this time point.

Figure 5.1 **Percentage of mothers initiating breastfeeding by UK country, 1980 to 2005**



Source: IFS – Stage 1 mothers (infants aged 4–10 weeks).

GUS found that, before the birth of their infant, 63% of mothers had intended to breastfeed. The proportion of infants ever breastfed at all (including those breastfed only in the first few days following birth) was around 60% of each of the two separate cohorts in the study. Mothers were more likely to intend to breastfeed (and to actually breastfeed) if they were first-time mothers, were in a relationship and living with their partner, had degree-level education and were in full-time employment. Infants in the baby cohort living in the least deprived areas were almost twice as likely to have been breastfed (77%) than infants in the most deprived areas (41%).

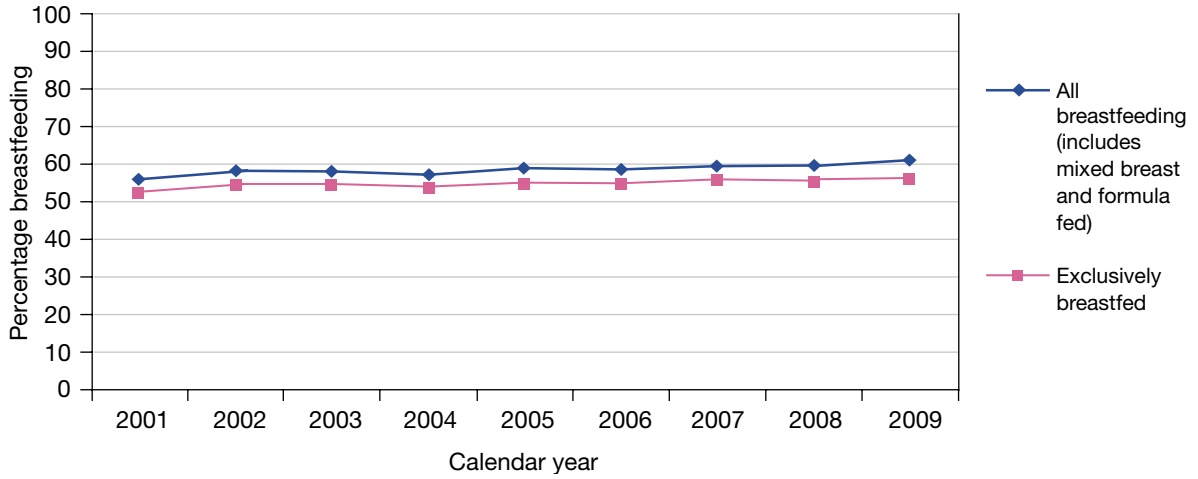
Routinely collected data

Information on feeding methods following the birth is collected at the first-visit review with the public health nurse and usually happens when the infant is 10 days old. Information is collated for NHS boards participating in the CHSP-PS system. All NHS boards in Scotland provide a Child Health Surveillance Programme in which children are offered reviews at various stages of their life. However, only 12 out of the 14 NHS boards submit information nationally through the CHSP-PS on breastfeeding at the first-visit review and 6–8 week review (all except Grampian and Orkney).

Information on breastfeeding at birth and aged 10 days is collected at the first-visit review. ISD Scotland data show that 60% of mothers were breastfeeding in total (including those using a combination of breastfeeding and formula feeding) and 56% were exclusively breastfeeding in Scotland following the birth in 2009 (Figure 5.2). This is a slight increase from 56% total breastfeeding and 52% exclusively breastfeeding in 2001.

Information is collected at the first-visit review, it relies on the mother recalling the information and could therefore overestimate breastfeeding rates. It is notable that these data, covering approximately 90% of births in Scotland, suggest breastfeeding initiation rates are lower than reported by surveys, which may use different definitions and experience selective participation. The IFS had an initial response rate of 62% and a response rate at 4–6 months of 54% in 2005.[36]

Figure 5.2 **Breastfeeding rates at birth in Scotland by year of birth, 2001 to 2009**



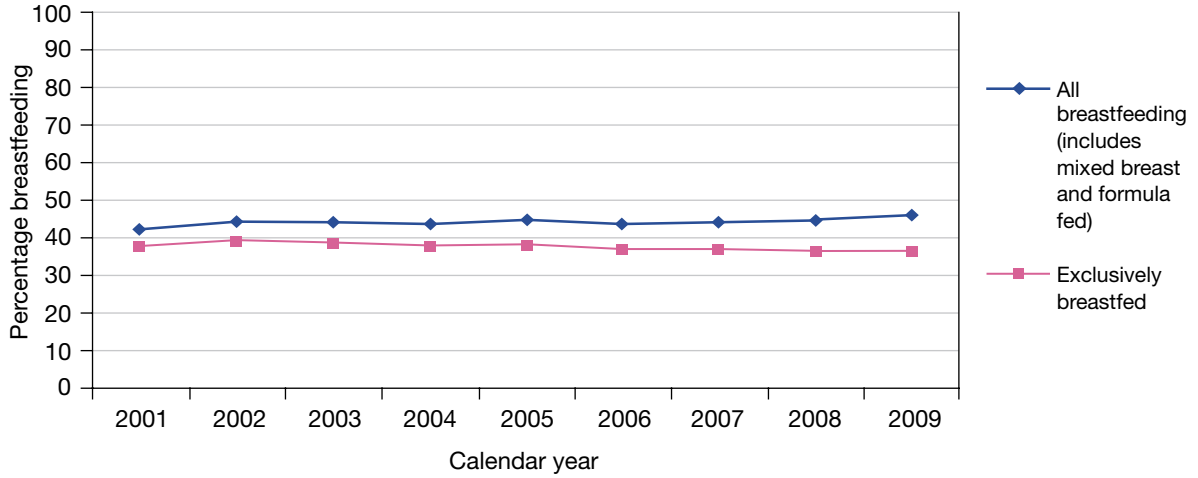
Source: ISD Scotland. Data for 2009 are provisional and are estimated to be around 99% complete.

Breastfeeding at the first-visit review

The mother is asked whether, in the last 24 hours, the infant has been exclusively breastfed, exclusively formula fed or has received mixed feeding (both breast and formula). As noted above, this does not match the WHO definition of exclusive breastfeeding, and it may not be asked consistently throughout Scotland.

In 2009, 46% of mothers were breastfeeding in total (including those using a combination of breastfeeding and formula feeding) and 37% were exclusively breastfeeding at the first-visit review (Figure 5.3). Breastfeeding rates at this 10-day visit have changed little since 2001.

Figure 5.3 **Breastfeeding at the first-visit review in Scotland by year of birth, 2001 to 2009**



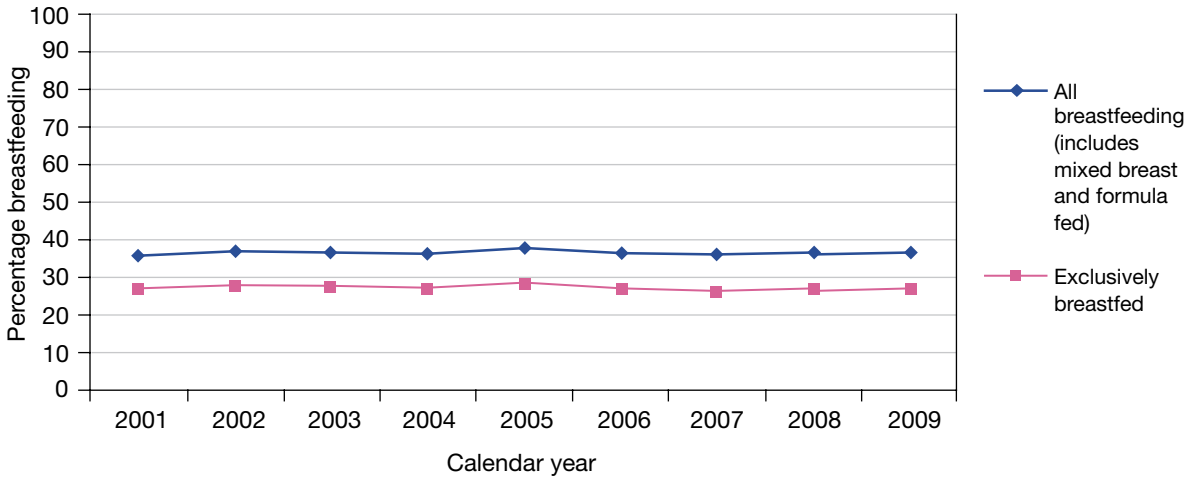
Source: ISD Scotland. Data for 2009 are provisional and are estimated to be around 99% complete.

Breastfeeding at the 6–8 week review

Information on feeding methods is collected again at the second public health nurse review following the birth of the infant, which is carried out when the infant is aged 6–8 weeks. This information is, again, for the past 24 hours only and does not match the WHO definition of exclusive breastfeeding.

At the 6–8 week review, 36% of mothers were breastfeeding in total and 27% were exclusively breastfeeding in 2009 (Figure 5.4). The rates have changed minimally since 2001. The Scottish Government has set NHS boards a health improvement target to increase the proportion of infants exclusively breastfed at 6–8 weeks from 27% in 2006/07 to 33% by 2010/11.[4]

Figure 5.4 **Breastfeeding at the 6–8 week review in Scotland by year of birth, 2001 to 2009**



Source: ISD Scotland. Data for 2009 are provisional and are estimated to be around 90% complete.

Breastfeeding duration

After the 6–8 week review, no further data are routinely collected in Scotland at clinic visits or health check-ups on feeding methods of infants. Survey data, which look at the proportion of mothers breastfeeding up to the age of 9 months, are available from the IFS. However, the proportion of mothers breastfeeding is higher in the IFS when compared with the proportion recorded routinely within the CHSP-PS system. This may be due to differences in the composition of the sample and the characteristics of the mothers participating in the IFS.

In 2005, the percentage of mothers breastfeeding in Scotland was lower than the UK average at all ages (Table 5.2). By 6 months, only 24% of mothers were still breastfeeding – around one in three of the 71% who initiate breastfeeding.

Table 5.2 **Percentage of mothers breastfeeding by age of infant, Scotland and the UK, 1995 to 2005**

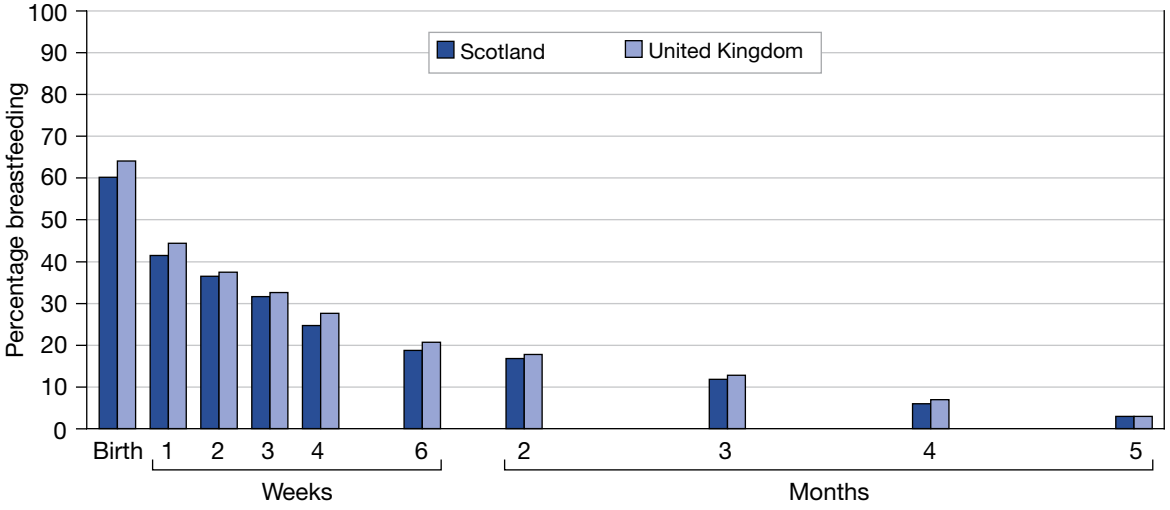
	Scotland			United Kingdom		
	1995	2000	2005	1995	2000	2005
Birth	55	63	71	66	69	76
2 days	–	–	66	–	–	72
3 days	–	–	63	–	–	70
4 days	–	–	61	–	–	67
5 days	–	–	59	–	–	66
6 days	–	–	58	–	–	64
1 week	46	50	57	56	55	63
2 weeks	44	47	54	53	52	60
6 weeks	36	40	44	42	42	48
4 months	24	30	31	27	28	34
6 months	19	24	24	21	21	25
9 months	13	15	15	14	13	18

Source: IFS – Stage 3 mothers (infants aged 8–10 months). Figures in this table differ from Table 5.1 as these are based on mothers whose babies had reached 9 months of age at the time of the survey.

– data not collected at this time point.

The IFS reported the proportion of mothers exclusively breastfeeding by age of the infant in all countries in the UK in 2005 (Figure 5.5). Scotland had a higher proportion of women exclusively breastfeeding at birth (61%) compared with Wales (58%) and Northern Ireland (55%), but this remained lower than both England (66%) and the UK average (65%).[36] The proportion of women exclusively breastfeeding decreases similarly in all countries in the UK, and less than 0.5% were exclusively breastfeeding at 6 months in all countries.

Figure 5.5 **Prevalence of exclusive breastfeeding by age of infant by country, 2005**



Source: IFS – Stage 3 mothers (infants aged 8–10 months).

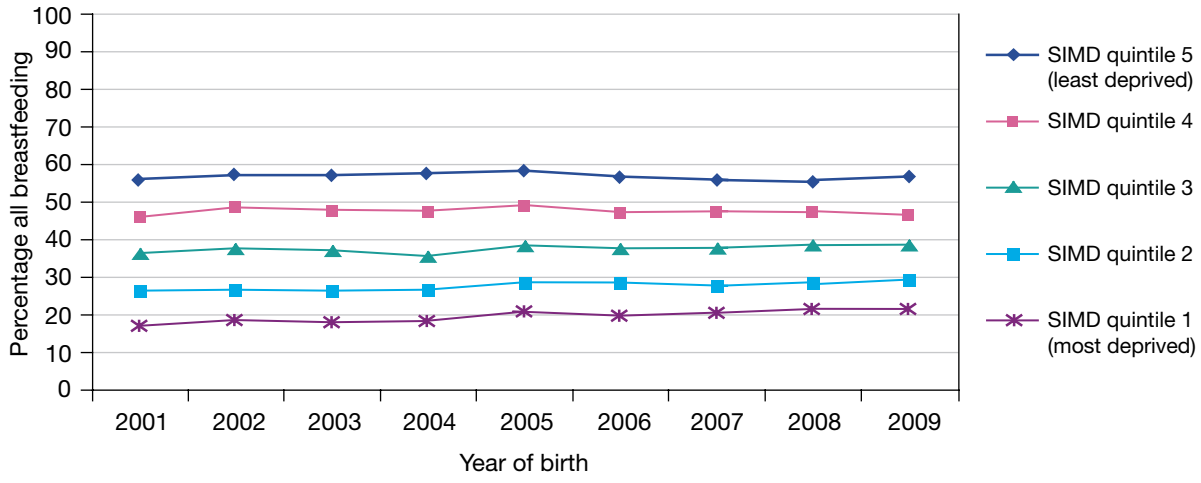
GUS found that just over 60% of infants in the baby cohort were ever breastfed. By 1 month of age a further 17% of the cohort had stopped breastfeeding, by 2 months only 36% of the total cohort were still being breastfed, decreasing to 27% at 4 months and just under 20% at 6 months of age. Only 11% of the total baby cohort were still being breastfed at the first interview (when infants were 10 months of age) and nearly 40% of all infants in the baby cohort were never breastfed.

Older mothers, those with degree-level education, mothers in a relationship, living in less deprived areas and those with a higher income were more likely to breastfeed for longer. Only 8% of mothers below 20 years of age were still breastfeeding at 6 months compared with over 33% of mothers in their thirties.

Breastfeeding and deprivation

There is an association between maternal deprivation and breastfeeding (Figure 5.6). This is seen at birth, the first-visit review (when the infant is around 10 days old) and the 6–8 week review. In 2009, 67% of mothers in the least deprived quintiles in Scotland were breastfeeding at the first-visit review compared with 30% in the most deprived quintiles. At the 6–8 week review, 57% of mothers in the least deprived quintiles were breastfeeding compared with 22% in the most deprived quintiles. The gap between the least and most deprived areas narrowed slightly between 2001 and 2009 because rates in the most deprived areas increased and rates in the least deprived areas were static (Figure 5.6). Similar trends were seen with breastfeeding at birth and at the first-visit review.

Figure 5.6 **Breastfeeding at the 6–8 week review by deprivation quintile in Scotland, 2001 to 2009**



Source: ISD Scotland. Data for 2009 are provisional and are estimated to be around 90% complete.

Breastfeeding and maternal age

Older mothers are more likely to breastfeed than younger mothers at both the first-visit review and the 6–8 week review in Scotland. Only 15% of mothers aged 20 years and under in Scotland were reported to be breastfeeding at the first-visit review compared with 60% of mothers aged 40 years and older. This was similar at the 6–8 week review, with 9% of mothers aged 20 years and under breastfeeding compared with 52% of mothers aged

40 years and older.[7] Data from the IFS suggest this pattern is similar in all countries in the UK.[36]

Formula feeding

The recommended alternative to breastfeeding is to use formula milk to feed the infant. Infant formula is available in powdered form, which needs to be dissolved in water, or in a ready-to-feed formula, which may be more convenient but is more expensive. The Food Standards Agency (FSA) states that full-fat cow's milk is not suitable for infants under 1 year of age as a main drink, semi-skimmed cow's milk is not suitable for infants under 2 years of age and skimmed cow's milk is not suitable for infants under 5 years of age.[49]

In Scotland, 38% of mothers in the IFS had first introduced formula milk into the infant's diet at birth, increasing to 98% by 9 months of age. This was slightly higher than the proportion in the UK (Table 5.3).

In the IFS 2005, 57% of mothers in Scotland were giving formula milk at all or almost all feeds by age 4–10 weeks. This was the same for the whole of the UK.[36]

Table 5.3 **Age at which formula milk first introduced to infant by country, 2005**

	England (%)	Wales (%)	Scotland (%)	Northern Ireland (%)	UK (%)
Birth	34	42	38	45	35
1 week	52	60	56	63	54
4 weeks	68	75	71	77	69
6 weeks	75	82	77	83	76
2 months	78	86	79	85	79
4 months	87	92	89	92	88
6 months	91	95	92	95	92
9 months	95	97	98	97	96

Source: IFS – Stage 3 mothers (infants aged 8–10 months). Figures in this table are based on a reduced number of cases excluding those babies who had not reached 9 months by stage 3.

The IFS compared how mothers reported preparing infant formula with the recommended FSA guidelines.[50] Infant formula is not sterile, and good hygiene practices are essential when preparing formula to decrease the chances of infants becoming ill. The main three recommendations analysed in the IFS are:

1. Ideally each bottle should be made fresh for each feed; formula milk should not be stored for future use.
2. Boiled tap water that has been allowed to cool for no more than 30 minutes should be used to make infant formula (natural mineral water should not be used as this contains high levels of minerals and can be harmful to the infant).
3. Water should be added to the bottle before the powdered infant formula is added.

The formula should be made according to the manufacturer's instructions, and any unused formula milk should be discarded within two hours. It is not always possible to make each infant formula feed fresh, although this is the ideal. If possible, ready-to-feed formula should be used in these circumstances. If this is not possible, infant formula can be made as recommended and then stored below 5°C but it should never be stored for more than

24 hours. Over three-quarters of mothers in Scotland using infant formula did not follow the Food Standards Agency recommendations and made up more than one feed at a time (Table 5.4).

Table 5.4 **How mothers usually make up formula feeds by country, 2005**

	England (%)	Wales (%)	Scotland (%)	Northern Ireland (%)	UK (%)
Only use ready-to-feed formula	5	4	5	2	5
Make up one feed at a time	27	20	18	19	25
Make up several feeds at a time	67	75	77	78	69

Source: IFS – Stage 1 mothers who used powdered formula in the last seven days (infants aged 4–10 weeks). Percentages may not add up to 100 because of rounding.

Only 59% of mothers in Scotland making infant formula followed the recommended guidelines using water that had been boiled and left to cool for no more than 30 minutes (Table 5.5).

Table 5.5 **Time usually left between boiling water and making up infant formula by country, 2005**

	England (%)	Wales (%)	Scotland (%)	Northern Ireland (%)	UK (%)
Use just-boiled water	23	22	27	19	23
Water left to cool for 30 minutes or less	36	41	32	42	36
All mothers following recommended guidelines	**58**	**63**	**59**	**61**	**59**
Water left to cool for 30–45 minutes	25	24	30	25	26
Water left to cool for more than 45 minutes	15	11	10	12	14
All mothers not following guidelines	**40**	**35**	**40**	**37**	**40**

Source: IFS – Stage 1 mothers who used powdered formula in the last seven days (infants aged 4–10 weeks). Percentages may not add up to 100 because of rounding.

Only 10% of mothers using infant formula in Scotland followed the three recommendations outlined by the FSA, and only 13% in the UK as a whole (Table 5.6).

Table 5.6 **Whether mothers followed all three recommendations when making infant formula by country, 2005**

	England (%)	Wales (%)	Scotland (%)	Northern Ireland (%)	UK (%)
Followed all three recommendations[a]	14	11	10	9	13
Followed two recommendations[b]	53	58	53	58	54

Source: IFS – Stage 1 mothers who used powdered formula in the last seven days (infants aged 4–10 weeks). Percentages may not add up to 100% because of rounding.

a Includes making up one feed at a time, using water boiled and cooled for less than 30 minutes and placing water in the bottle before the powdered formula.

b Includes following the two recommendations to use water boiled and cooled for less than 30 minutes and placing water in the bottle before the powdered formula only.

Follow-on formula (second-stage formula)

The FSA states that follow-on formula is not necessary in the infant's diet at any stage, and instead full-fat cow's milk should gradually be introduced into the diet from 12 months of age.[51] Follow-on milks are designed and promoted to be used between formula milk and the introduction of cow's milk at 12 months of age. They contain an increased amount of iron, but introduction of solid foods from 6 months of age should increase iron intake naturally from other food sources.[52] Although follow-on milk should not be introduced before 6 months of age (as it is difficult for the infant to digest), 10% of mothers in Scotland had given follow-on milk to their infant before this stage (Table 5.7).

Table 5.7 **Proportion of mothers who had ever given their infant follow-on formula milk at Stages 2 and 3 by country, 2005**

	England (%)	Wales (%)	Scotland (%)	Northern Ireland (%)	UK (%)
Stage 2 (4–6 months)	11	13	10	11	11
Stage 3 (8–10 months)	54	51	45	46	53

Source: IFS – Stage 2 mothers (infants aged 4–6 months) and Stage 3 mothers (infants aged 8–10 months).

Nutrient intake and nutritional status

We were unable to identify any large-scale studies on nutrient intake or nutritional status of vitamin D, iron or calcium in infants prior to weaning in Scotland or the UK. Also, as measuring and interpreting the nutritional status of calcium is complex, there is no routine method for measuring the nutritional status of calcium from blood samples alone.

For completeness, the reference nutrient intakes (RNIs) are given below.

The RNI of vitamin D for infants from birth to 6 months is 8.5 micrograms per day (µg/day).[9]

The RNI of iron for infants from birth to 3 months is 1.7 milligrams per day (mg/day), increasing to 4.3 mg/day for 4–6 months of age.[9]

The RNI of calcium for infants from birth to 12 months is 525 mg/day.[9]

Introducing solid foods (weaning)

For this section, we sought data on general diet, obesity and weight gain, and nutrient intake and nutritional status of vitamin D, iron and calcium in infants following the introduction of solid foods into their diet in Scotland and the UK. Data have been included from the Avon Longitudinal Survey of Parents and Children (ALSPAC), IFS and GUS. We were unable to identify any Scottish studies providing robust measurement of nutrient intake or nutritional status in infants following introduction of solid foods into their diet.

The process of introducing solids into the infant's diet is commonly referred to as weaning. After the age of 6 months an infant requires more nutrients than breast milk or infant formula alone can provide.[36] The introduction of solid foods is thus a very important part of infant nutrition.

The recommended age of introduction of solid foods is around 6 months for all infants. The WHO in 2003 recommended that solid foods should not be introduced until the infant is 6 months of age. Prior to this, the recommendation was from 4 months of age. Scottish Government guidance in 2009, consistent with the WHO, advised that solids should be introduced around 6 months of age.[53] Introducing solids into the diet before 6 months of age may increase the risk of infections or allergies because of the infant's digestive system not being fully developed. Eating habits learnt within the first few years of life can have a long-term effect on diet and health.[54]

General diet

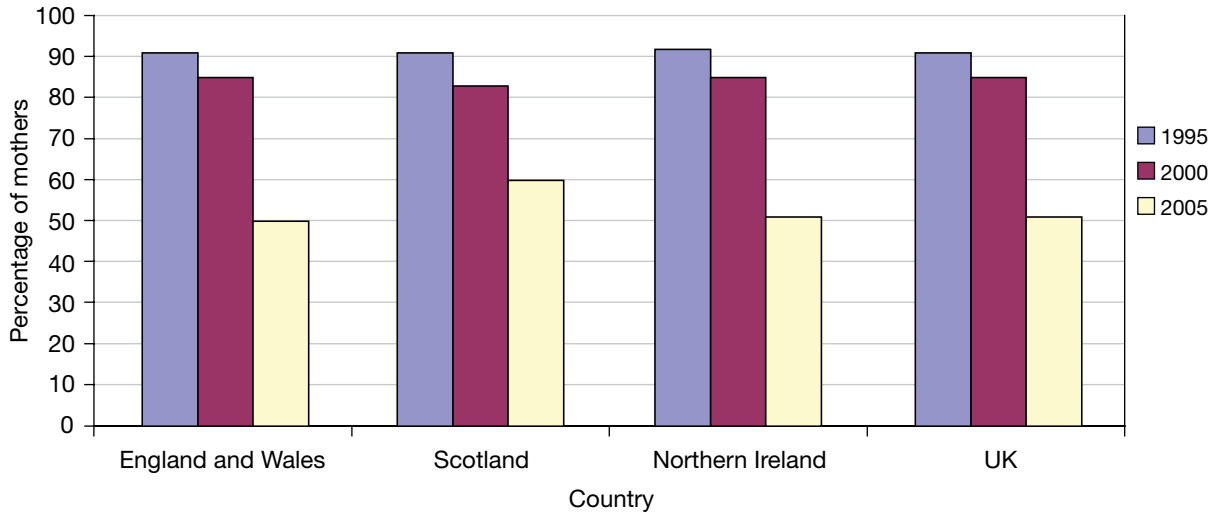
It is recommended that the amount and variety of foods are gradually increased from around the age of 6 months so that, by the age of 12 months, food rather than milk is the main part of an infant's diet. Suitable first foods include fruits, vegetables and baby rice. Parents are advised to use foods prepared at home (without salt or sugar added) rather than commercially made baby foods so that the infant becomes accustomed to eating family foods.

ALSPAC found that the timing of the introduction of lumpy food into the infant's diet had a significant effect on whether infants became fussy eaters as toddlers. The earlier infants were introduced to fruit and vegetables, the more likely they were to eat fruit and vegetables at 7 years of age.[55] The timing of weaning is important, and developing knowledge has seen changes in guidance within recent years.

Current weaning in Scotland and the UK

The IFS shows a general shift towards mothers introducing solid foods into the infant's diet at a later stage (Figure 5.7). By 4 months of age, 60% of mothers participating in the IFS in Scotland had introduced solids into the infant's diet in 2005 compared with 83% in 2000 and 91% in 1995.

Figure 5.7 **Percentage of mothers who had introduced solids at 4 months of age by country, 1995 to 2005**



Source: IFS.

Although these results show a general shift towards mothers following the revised WHO guidelines, only 2% of mothers in the UK in 2005 waited until 6 months of age before introducing solid foods into the infant's diet.[36] The IFS also found that the nature of weaning varied by the mother's socio-economic status. Women in managerial or professional occupations were more likely to feed their infants fruit and vegetables rather than sweets or other snacks.[1,36]

GUS found that 16% of infants in the baby cohort recruited from sweep one in 2005/06 received solids before 4 months of age. A further 44% were started on solids at 4 months of age and 21% were started at 5 months of age. Only 19% were started at 6 months or later. Younger mothers, lone parents and those bottle feeding were more likely to introduce solids earlier than older mothers, those in couple-households and those who had been breastfeeding. One in four mothers in their twenties had introduced solids before 4 months compared with just one in ten mothers in their thirties.[56]

ALSPAC used 3-day diet diaries to assess the nutrient intake of infants. At 8 months of age, 34% did not eat any fruit and 25% did not eat any vegetables during the 3-day diary period and 26% had eaten chocolate.[57]

Infant weight and weight gain

We sought to identify available data on infant weight and weight gain in Scotland. This information is not routinely collected and, while the opportunity to measure and record infant weight is possible during routine appointments within the NHS, there are currently no mandatory growth measurements recorded following the 6–8 week review until the infant starts school at around 5 years of age.

We were unable to identify any large-scale studies on the proportion of infants defined as being overweight or obese or any studies on weight gain in infants following introduction of solids into their diet in Scotland or the UK.

Nutritional status

We were unable to identify any large-scale studies on nutritional status of vitamin D or iron in infants after completion of weaning onto solid foods in Scotland or the UK. Also, as measuring and interpreting the nutritional status of calcium is complex, there is no routine method for measuring this from blood samples alone. We were therefore unable to identify any large-scale studies assessing the nutritional status of calcium in infants after initiation of weaning in Scotland or the UK.

Vitamin D

Nutrient intake

The RNI of vitamin D for infants aged between 7 and 12 months is 7 µg/day.[9]

The Department of Health (DoH) advises that infants should be given vitamin drops containing vitamins A, C and D from 6 months of age if they are breastfed or receiving less than 500 millilitres (ml) of formula milk per day.[54]

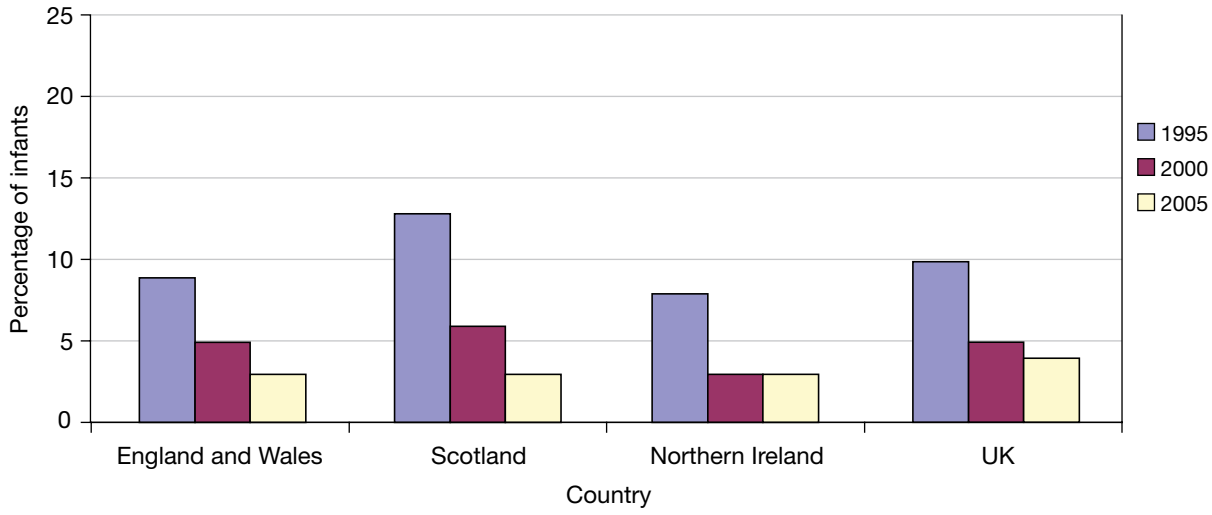
We were unable to identify any large-scale studies on vitamin D intake in infants after the initiation of weaning in Scotland or in the UK.

ALSPAC used 3-day unweighed dietary records in 1,131 infants to assess food and nutrient intake in children at 8 months of age. Median vitamin D levels (5.2 µg/day) were lower than the RNI of 7 µg/day for this age.[57]

The IFS did not specifically ask questions about vitamin D intake but did ask if the infant was receiving supplementary vitamins at different ages. At 4–6 months of age, 3% of infants were receiving vitamins in 2005, decreased from 13% in 1995 (Figure 5.8). At 8–10 months old, 4% were receiving vitamins in Scotland in 2005.[36]

An indirect measure of vitamin D deficiency is the incidence of hypocalcaemia-induced seizures and rickets.[11] Rickets can also occur in cases of calcium deficiency. However, most cases present at GP appointments, hospital outpatient and accident and emergency departments, where comprehensive diagnostic information is not nationally collected. It is therefore not possible to calculate the incidence of hypocalcaemia in infants in Scotland.

Figure 5.8 **Percentage of infants receiving supplementary vitamins at age 4–6 months in UK countries, 1995 to 2005**



Source: IFS.

Iron

Nutrient intake

The RNI of iron for infants from birth to 3 months is 1.7 mg/day, increasing to 4.3 mg/day from 4–6 months of age and to 7.8 mg/day from 7–12 months of age.[9]

We were unable to identify any large-scale studies on iron intake in infants after the initiation of weaning in Scotland or in the UK.

ALSPAC used 3-day unweighed dietary records in 1,131 infants to assess food and nutrient intake in children at 8 months of age. Median iron levels (8.1 mg) were higher than the RNI of 7.8 mg/day for infants of this age.[57]

In another ALSPAC study, iron levels were compared in 1,079 infants at 8 months of age and 906 infants at 12 months of age to assess the effect of type of milk received on iron levels.[58] At 8 months of age, 12% of infants were receiving breast milk, 74% were receiving formula milk and 14% were receiving cow's milk. At 8 months of age, 7% of the infants were defined as being anaemic using the ALSPAC threshold of 100 grams per litre (g/l) and 23% using the WHO threshold (110 g/l). At 12 months of age the proportion defined as anaemic had dropped to 4% and 8%, respectively. Drinking only cow's milk was associated with higher levels of anaemia.

An indirect measure of iron deficiency is the incidence of anaemia. However, most cases of anaemia present at GP appointments and occasionally in hospital outpatient and accident and emergency departments, where comprehensive diagnostic information is not nationally collected. It is therefore not possible to calculate the incidence of anaemia in infants in Scotland.

Calcium

Nutrient intake

The RNI of calcium for infants from birth to 12 months is 525 mg/day.[9]

We were unable to identify any large-scale studies on calcium intake in infants after the initiation of weaning in Scotland or in the UK.

ALSPAC used 3-day unweighted dietary records in 1,131 infants to assess food and nutrient intakes in children at 8 months of age. The study found that median calcium levels at 628 mg were above the RNI.[57]

An indirect measure of calcium deficiency is the incidence of rickets in infants. Rickets can also occur in cases of vitamin D deficiency.[11] However, most cases of rickets present at GP appointments, hospital outpatient and accident and emergency departments, where comprehensive diagnostic information is not nationally collected. It is therefore not possible to calculate the incidence of rickets in infants in Scotland.

Nutrition between 12 months and 3 years

The importance of nutrition following the introduction of solid foods into the infant's diet is well recognised.[59] For this section, we sought information on general diet, nutrient intake and nutritional status of vitamin D, iron and calcium in infants after completion of weaning onto solid foods in Scotland and the UK.

We were unable to identify any Scottish studies providing robust measurement of nutritional status in infants after completion of weaning onto solid foods. For nutrient intake, a UK survey including a Scottish sample was identified – the NDNS (1½ to 4½ years) – and results from this are presented for the UK and Scotland where possible. The Scottish sample size was too small to be adequately representative of the Scottish population as a whole and cannot be directly compared with results for the UK sample. This survey is also dated, having been undertaken in 1992–1993. Data have also been included from GUS and the ALSPAC.

General diet

From the age of 12 months, infants should be eating three small meals and one or two nutritious snacks each day. Infants should be encouraged to eat foods from each of the four main food groups (bread, rice, potatoes, pasta and other starchy foods; fruits and vegetables; meat, fish, eggs, beans and other non-dairy sources of protein; milk and dairy foods) to ensure that they receive all the nutrients and energy they need for growth and development. Up to the age of 2 years, infants have high energy requirements compared with older children and adults, so need more fat in their diet.

In the second year of GUS, when the baby cohort was approximately 22 months old, 97% ate at least one type of fruit a day, including 59% who had two or three types per day and 25% who had four or more. Only 9% of the children had four or more types of vegetable per day, 61% had two or three types per day, 24% had only one type per day and 6% had no vegetables in a normal day. More than 43% of children had sweets or chocolate at least once a day, 12% had non-diet soft drinks at least once a day and 46% had crisps or savoury snacks at least once a day.[60]

ALSPAC used 3-day diet diaries to assess the nutrient intake of infants. At 18 months of age, 16% did not eat any fruit and 8% did not eat any vegetables during the three days. However, during the 3-day diet period, 63% had eaten chocolate and 66% had eaten savoury snacks.[61]

Infant weight and weight gain

We sought to identify available data on infant weight in Scotland. This information is not routinely collected in Scotland. Although the opportunity to measure and record infant weight is possible during routine appointments within the NHS, there are currently no mandatory growth measurements recorded following the 6–8 week review until the infant starts school at around 5 years of age.

We were unable to identify any large-scale studies on weight or weight gain in infants after completion of weaning onto solid foods in Scotland or the UK.

Nutritional status

We were unable to identify any large-scale studies on nutritional status of vitamin D or iron in infants after completion of weaning onto solid foods in Scotland or the UK. Also, because measuring and interpreting the nutritional status of calcium is complex there is no routine method of measuring this from blood samples alone. We were therefore unable to identify any large-scale studies assessing the nutritional status of calcium in infants after completion of weaning onto solid foods in Scotland or the UK.

Vitamin D

Nutrient intake

The RNI of vitamin D for infants from 12 months to 3 years of age is 7 µg/day.[9] There is no LRNI for vitamin D for infants of this age.

The NDNS (1½ to 4½ years) provided detailed information on vitamin D intake from food sources (Table 5.8) and from all sources (Table 5.9). Scottish infants' median intake of vitamin D was similar to that for the UK as a whole.

Mean vitamin D intake from food sources was only 18% of the RNI for infants under 4 years of age. However, because vitamin D can be synthesised from sunlight, the survey assessed access to gardens or communal play areas and found that over 90% of infants in the survey had access to these areas.[62] Whether exposure to sunlight in Scotland provides adequate vitamin D is, however, open to question.

Table 5.8 **Vitamin D intake in infants from food sources *only*, 1992–1993**

Survey	Year	Area	Age range (years)	Median daily intake (µg)	Median (% RNI)
NDNS (1½ to 4½ years)	1992–1993	UK	1½–2½	0.9	13
		UK	2½–3½	1.0	14
		UK	1½–4½	1.0	14
		Scotland	1½–4½	1.1	16

Source: NDNS (1½ to 4½ years).

Table 5.9 **Vitamin D intake in infants from *all* sources, 1992–1993**

Survey	Year	Area	Age range (years)	Median daily intake (µg)	Median (% RNI)
NDNS (1½ to 4½ years)	1992–1993	UK	1½–2½	1.0	14
		UK	2½–3½	1.2	17
		UK	1½–4½	1.1	16
		Scotland	1½–4½	1.1	16

Source: NDNS (1½ to 4½ years).

Total energy intake increases with age as the infant increases in size. However, the NDNS (1½ to 4½ years) found that infants aged 1½–2½ years had significantly higher vitamin D intake per 1,000 kilocalories (kcal) energy intake than older infants. This reflects the change in infant diets with age from formula feeding or manufactured weaning foods, both fortified with vitamin D, to a more varied diet with less rich sources of vitamin D. Infants in the younger age group received 17% of their mean vitamin D intake from other milk and products, which includes infant formula. The other main sources of vitamin D were fortified fat spreads (26%) and breakfast cereals (17%).

Iron

Nutrient intake

The RNI of iron for infants from 7–12 months of age is 7.8 mg/day and from 12 months to 3 years of age is 6.9 mg/day. The lower reference nutrient intake (LRNI) for infants from 7–12 months is 4.2 mg/day and from 12 months to 3 years is 3.7 mg/day.[9]

The NDNS (1½ to 4½ years) provided detailed information on iron intake from food sources (Table 5.10) and from all sources (Table 5.11). Scottish infants' median intake of iron was lower than for infants in the UK as a whole. The survey did not report the percentage of infants below the LRNI in Scotland. Intake of iron was higher in older infants.

Table 5.10 **Iron intake in infants from food sources *only*, 1992–1993**

Survey	Year	Area	Age range (years)	Median daily intake (mg)	Median as a percent of 6.9 mg/day RNI (%)	Infants below LRNI (%)
NDNS (1½ to 4½ years)	1992–1993	UK	1½–2½	4.7	68	25
		UK	2½–3½	5.3	77	12
		UK	1½–4½	5.2	75	15
		Scotland	1½–4½	4.6	67	–

Source: NDNS (1½ to 4½ years).

– not reported at Scotland level.

Table 5.11 **Iron intake in infants from *all* sources, 1992 to 1993**

Survey	Year	Area	Age range (years)	Median daily intake (mg)	Median as a percent of 6.9 mg/day RNI (%)	Infants below LRNI (%)
NDNS (1½ to 4½ years)	1992–1993	UK	1½–2½	4.7	68	24
		UK	2½–3½	5.4	78	12
		UK	1½–4½	5.3	77	15
		Scotland	1½–4½	5.1	74	–

Source: NDNS (1½ to 4½ years).

– not reported at Scotland level.

ALSPAC found that haemoglobin levels at 18 months of age were higher in children who ate any fruit or vegetables and were lower in infants consuming high levels of milk and dairy products.[63]

Calcium

Nutrient intake

The RNI of calcium for infants from 12 months to 3 years of age is 350 mg/day and the LRNI is 200 mg/day.[9]

The NDNS (1½ to 4½ years) provided detailed information on calcium intake from food sources. Intake is lower in Scotland than in the UK as a whole, although it is still well above the RNI (Table 5.12).

Table 5.12 **Calcium intake in infants from food sources *only*, 1992–1993**

Survey	Year	Area	Age range (years)	Median daily intake (mg)	Median as a percent of 350 mg/day RNI (%)	Infants below LRNI (%)
NDNS (1½ to 4½ years)	1992–1993	UK	1½–2½	639	189	1
		UK	2½–3½	598	171	1
		UK	1½–4½	606	173	1
		Scotland	1½–4½	512	146	–

Source: NDNS (1½ to 4½ years).

– not reported at Scotland level.

Dietary supplements had a negligible effect on calcium intake and were not reported at a UK level. Calcium intake from all sources in Scotland was 560 mg/day (160% of RNI). The survey did not report the percentage of infants below the LRNI in Scotland.

Milk and milk products were the main sources of calcium in the diet of infants aged 1½–4½ years in the survey, providing 64% of the mean intake of calcium, with cereals and cereal products providing 19%.

6 Discussion and conclusion

Improving the diet and nutrition of people in Scotland is recognised as important for the health of the population.[4] This is especially important during pregnancy and in infancy because a poor diet at these stages can cause long-term health problems in later life.[2] The Scottish Perspective on NICE guidance: Maternal and Infant Nutrition has identified improving nutritional health as a priority, and significant investments are being made in this area.[64,65] The Scottish Government is developing a strategy to improve maternal and infant nutrition. To inform the strategy, this review describes current maternal and infant diet and nutrition status in Scotland using surveys, routine administrative data sources and ad hoc studies.

Data

There are limited data available on maternal and infant nutrition in Scotland. No routinely collected data in Scotland are available on maternal nutrition before, during or after pregnancy. Results from the Southampton Women's Survey (SWS) suggest little change in dietary patterns before and during pregnancy; therefore, the diet of women of childbearing age was assessed. Only one ad hoc Scottish study, conducted in 2000–2006, was identified, providing some information on nutrient intake and nutritional status during pregnancy. However, its published results are broken down by deprivation, and reanalysis to give results for the cohort as a whole would be valuable.[29] Data are collected on the mother's height and weight at her first appointment with a midwife in Scotland. This information is not currently published but work is under way to assess the quality of these data. There are some data collected on infant nutrition following the birth in Scotland. Information on breastfeeding at birth, 10 days and 6–8 weeks is available; however, nothing is collected nationally thereafter from routine contacts within the NHS. Data are not collected on the weight of the infant after the 6–8 week review until they start school at around 5 years of age.

Three detailed dietary surveys are available, providing information on the diet of women of childbearing age and infants: the National Diet and Nutrition Survey (NDNS) for adults conducted in 2000 to 2001, the Low Income Diet and Nutrition Survey (LIDNS) conducted in 2003 to 2005 and the National Diet and Nutrition Survey for Infants [NDNS (1½ to 4½ years)] conducted in 1992 to 1993. However, their Scottish samples were small, which further limits the analysis possible.

Two studies from England, one dating from a cohort of pregnant women recruited in 1991 to 1992 [Avon Longitudinal Study of Parents and Children (ALSPAC)] and the other recruiting women during 1998 to 2002 (SWS) provide information on maternal and infant nutrition during and after pregnancy in England. Other survey sources, such as the Scottish Health Survey (SHeS), Growing Up in Scotland (GUS) and the Infant Feeding Survey (IFS), provide some information on general diet, obesity, breastfeeding and weaning. However, they provide no detailed information on nutrient intake and nutritional status of women before, during or after pregnancy or in infants following the introduction of solid foods into their diet.

The importance of nutrition during pregnancy on the developing infant and the effect of this on health outcomes in later life is well evidenced.[2] If post-birth nutrition is substantially different from that to which the infant has been exposed *in utero*, this can increase the risk of diabetes, cardiovascular disease and other conditions. This is partly reflected in the pattern of infant weight gain, which is monitored using growth charts. The World Health Organization (WHO) growth charts were developed following a study of optimum growth in children. The study plotted the growth pattern in breastfed children as a reflection of optimum growth. The new UK-WHO growth charts were introduced in Scotland for all infants born on or after 1 January 2010. At present, this information is used clinically and the value of, and potential for, collating this information centrally could be considered as a further possible low-cost way of monitoring the population impact of nutritional interventions.

Making comparisons between different sources or over time is difficult. Results can be reported for dietary intake, nutrient intake, nutritional status or a combination of these (and other intake such as supplements). Results may be presented as means, medians or proportions in relation to thresholds. They may be presented for slightly differing age groups.

Many of the sources used represent major scientific undertakings, but it is difficult to feel satisfied that they have enabled us to adequately describe the story of maternal and infant nutrition in Scotland in 2010. This review has identified specific gaps in information: dietary and nutrient intake and nutritional status during pregnancy and post pregnancy, maternal and infant obesity and weight gain, and infant nutrition during weaning and post weaning. Although there is good routine information available on breastfeeding annually through the Information Services Division Scotland (ISD Scotland) and quinquenially through the IFS, there is scope for further development and improvement to meet policy needs.

Assessing the impact of the maternal and infant nutrition strategy will require a monitoring framework that is consistent, scientifically well founded but also achievable without a major diversion of resources that might otherwise be used to implement the strategy. There is some evidence that infant diet, including breastfeeding duration, varies in line with the quality of maternal diet, and that maternal diet reflects the diet of women of childbearing age.[1,19,32,66,67] If these factors are indeed all inter-related, then improving the diet of women of childbearing age would have an impact on the diet of the mother during pregnancy, breastfeeding and the diet of the infant following the introduction of solid foods. It is therefore important to monitor the diet of women of childbearing age and breastfeeding as potential indicators of diet during pregnancy and the diet of the infant following the introduction of solid foods. It is timely that the Food Standards Agency (FSA) has commissioned the NDNS of adults and children to run continuously from 2008 to 2011. The Scottish sample has been boosted for this survey, and the first-year report was published in early 2010 for UK data, although Scottish data will not be available until 2012 once the full sample has been accumulated. The FSA is also in the process of piloting a new national nutrition survey of infants in the UK, which will provide detailed individual diet and nutrition data on a random sample of infants between the age of 4 and 18 months.

The cost-effectiveness of focused surveys on pregnant and breastfeeding women would need to be assessed prior to their implementation compared with utilising or enhancing existing data. The diet and nutrition information collected in existing data sources such as the SHeS and GUS could be enhanced, as they currently collect very limited dietary data and no information on nutrient intake or nutritional status other than obesity. Furthermore, linking these to health records would reduce the need for new data collection, with the

costs and development time that new data collection involves. GUS is recruiting a new birth cohort in January 2011 and this will allow further information to be gathered on breastfeeding, introduction of solid foods and general diet.

Nutrition of women of childbearing age and during pregnancy

National surveys would suggest that most women do not meet the current dietary guidelines. Diets continue to be high in saturated fat and sugar and below the recommended intake for fruit and vegetables, oil-rich fish and dietary fibre.[25] Moreover, the poorest diets, and therefore suboptimal nutritional status, are consistently found in women from the most disadvantaged groups. There are highly consistent findings of social inequalities in nutrient intake by a number of measures of socio-economic status, including income, educational attainment and deprivation. These findings suggest that dietary intake in women is strongly influenced by socio-economic status.[23]

Currently, there are no national data available to describe the nutrient intake and nutritional status of pregnant women. Data from the NDNS and LIDNS can provide nutrient intake and nutritional status of women of childbearing age, which may give some indication of the nutrient intake and nutritional status at the beginning of pregnancy. Some women did not meet the recommended intake of iron or folate required for pregnancy, but a high proportion of women met the recommended intake of calcium. There is no recommended intake of vitamin D for women of childbearing age, although women are advised to take a supplement during pregnancy. In general, a higher proportion of women from low-income households had intakes below the lower reference nutrient intake (LRNI) and low nutrient status. It is therefore likely that a significant proportion of young women enter pregnancy with suboptimal levels of some nutrients.

Over one-half (52%) of women aged 16–44 years in the SHeS were classified as overweight or obese in 2008. Obesity at the start of pregnancy is associated with an increased health risk to both the mother and infant.[33,34] Although the height and weight of the mother is recorded at the first NHS appointment of their pregnancy, these data are not published and further work is required to assess their quality and utility.

A recent large-scale cohort study in Aberdeen assessed diet and nutrient intake during pregnancy in 1,461 women. In general, poor food choices were consistent with poor nutrient intake, and there was a strong social gradient across deprivation deciles. There was evidence of poor intake for some nutrients influencing pregnancy outcome.

Pregnant women are advised to take supplements of both folic acid and vitamin D during pregnancy. Over three-quarters (77%) of women in Scotland had taken folic acid supplements at some point in the first 3 months of pregnancy. However, folic acid supplement intake remains well below the Department of Health (DoH) recommendation of 400 micrograms per day (µg/day) before pregnancy and until the 12th week of pregnancy, and questions from the IFS do not indicate whether the amount of folic acid taken and the timing is consistent with the current recommendation. There are no data for folic acid supplementation for women in Scotland before conception, but only 1 in 20 women participating in the SWS had taken the recommended amount in the three months before conception. Women are also advised to eat foods rich in folate and folic acid to increase their nutrient intake to 300 µg/day for the duration of their pregnancy.[13,14] However, not all publicly available documents reflect this current guidance, allowing for possible confusion

regarding dietary intake during pregnancy.[15] Although the majority of vitamin D requirements should be met from the action of ultraviolet light on the skin, it is more difficult for those living in northern latitudes to meet requirements. As a result of this, pregnant women are recommended to have a supplement of 10 µg/day. There is no specific information available on uptake of vitamin D supplementation during pregnancy in Scotland; results from the IFS suggest that only 6% of women took a supplement other than folic acid.

Infant nutrition

The breastfeeding initiation rate was 70% in Scotland in 2005. However, breastfeeding rates fall rapidly even during the first few days of life. In the same source (IFS), the rate had fallen to 57% by 1 week, 44% by 6 weeks, and 24% by 6 months. These may be optimistic figures owing to recruitment and retention in a voluntary study. Routine data covering approximately 90% of births in Scotland give a rate for 2009 of only 36% breastfeeding at 6–8 weeks.

Information collected from national surveys and routine data sources show clear associations between breastfeeding and deprivation, and also with maternal age. Mothers in the least deprived areas in Scotland are more likely to breastfeed than those in the most deprived areas, and breastfeeding is more likely to occur with older mothers.[7,36]

Although breastfeeding is the recommended optimal method of feeding from birth, the only safe alternative method of feeding is to use infant formula milk. Over one-half of mothers in Scotland were using infant formula for almost all feeds by the time infants were aged 4–10 weeks.[36] The FSA states that follow-on formula is not necessary at any stage and should not be introduced into the infant's diet before 6 months of age. Despite this recommendation, 10% of mothers in Scotland had given follow-on formula milk to their infant before this stage.[36,51]

The introduction of solid foods is an important stage in the development of the infant. Although there has been a definite shift towards introducing solid food at a later stage, most infants (98%) in Scotland had solids introduced into their diet before the recommended age of 6 months.[36]

There is little information available on the diet of infants between the initiation of weaning and their third birthday. The most detailed information on the diet of infants is from the NDNS, which is now over 17 years old. Although this information should be treated with some caution, it does suggest that infants were receiving above the recommended daily intake of calcium but low levels of vitamin D and iron from their diets.

However, the ALSPAC study provides more recent evidence from southern England and suggests that, while vitamin D levels were still below the reference nutrient intake (RNI), iron intake was higher for this sample of infants at 8 months and 12 months of age, with only a small proportion of infants found to be anaemic.

Progress

We are limited to considering only those few aspects of nutrition for which consistent data are available over time.

The recent review of progress towards improvement of the general diet in Scotland indicated that there has been little change to the adult diet in Scotland since 1996 when the Scottish dietary targets were introduced.[21] Very small improvements have been made towards achieving targets for fruit and vegetables, brown/wholemeal bread and oil-rich fish, but there has been no reduction in the intake of fat, saturated fat and added sugar, which remain well above recommended levels.

There was no change in the proportion of women of childbearing age in Scotland consuming five portions of fruit and vegetables per day between 2003 and 2008, and data are unavailable from the SHeS before this time. However, there was a decrease in those consuming no fruit or vegetables, from 12% to 9%.

Scotland continues to have a low level of breastfeeding, despite the evidence supporting its benefits and the effort put into its promotion. In Norway, the initiation rate for breastfeeding is over 90% compared with 60–70% in Scotland (depending on data source).[68] The WHO currently advises mothers to exclusively breastfeed their infants to the age of 6 months, but in Scotland in 2005 only 24% of mothers were still breastfeeding at all at this stage, compared with 80% in Norway.[68]

There is nothing inevitable about Scotland's low breastfeeding rate. In 1910 in Glasgow, around two-thirds of women were breastfeeding at 6 months.[69] However, the current low rates are persistent. The IFS suggests that breastfeeding rates at 6 weeks rose from 36% in 1995 to 40% in 2000 and 44% in 2005 in Scotland, although data from ISD Scotland for approximately 90% of births in Scotland show no change over the period 2001–2009. Many studies have found that breastfeeding rates are higher in older women and in women with degree-level education, in relationships, living in more affluent areas and earning higher incomes.

The reduction in neural tube defects (NTDs) might be taken as weak, indirect evidence of increased use of folic acid. However, the decrease is slight and not consistent over time. Other evidence suggests that, although many women take folic acid, few take the correct amount at the right time.[3] This shows the difficulty of changing individual behaviour, even when the target audience is well defined, the message simple, the behaviour easy to undertake and the personal financial cost minimal. And in the case of folic acid, it is difficult to argue that progress is impeded by cultural context or commercial counter-messages, such as those that impede progress on breastfeeding.

Progress in improving maternal and infant nutrition thus appears to have been slow. The forthcoming maternal and infant nutrition strategy offers an opportunity to increase the speed of progress by supporting wider cultural as well as personal behavioural change.

Conclusion

There is neither sufficient nor sufficiently timely data available on maternal and infant nutrition in Scotland. This must be remedied if a robust assessment of future progress in improving maternal and infant nutrition is to be made. However, repeated nutrition surveys are expensive long-term undertakings and, as much as possible, existing routine administrative, clinical and survey data sources should be improved and exploited to monitor behavioural, social and cultural change, including relevant change in the commercial environment (e.g. the way in which products are advertised and product placement in entertainment media), at a population level.

Appendix A: Main sources used in this review

Avon Longitudinal Study of Parents and Children (ALSPAC)

This study recruited 14,541 pregnant women between April 1991 and December 1992, with the aim of looking at environmental and genetic determinants of development and health of their infants. Information was collected from the mother, partner and infant during pregnancy and following the birth. The survey looked at many aspects of the life of the mother, partner and infant by using questionnaires, clinic assessments, biological samples, linkage to routine data, medical records information and environmental monitoring. ALSPAC included very detailed dietary questionnaires in pregnancy and at different stages after the infant was born.

Website: www.bristol.ac.uk/alspac/

Diet and deprivation in pregnancy, a study from Aberdeen University (Aberdeen cohort study)

This prospective cohort study recruited 1,461 women during their pregnancy in Aberdeen from 2000 to 2006. Deprivation was measured using the Scottish Index of Multiple Deprivation 2004. Women provided a blood sample at approximately 19 weeks' gestation to assess folate and vitamin B_{12} nutritional status during pregnancy. A food frequency questionnaire was also completed by participants at 19 weeks' gestation to assess dietary and nutrient intake during pregnancy.[29]

This study is not available online.

Growing Up in Scotland (GUS)

GUS is a longitudinal research project tracking the lives of a cohort of children in Scotland. Children were selected using child benefit records held by the Department of Work and Pensions, and parents were invited to participate in the study. In 2005/06, 5,217 infants aged 10 months (referred to in this review as the 'baby cohort') and 2,859 aged 34 months (referred to in this review as the 'child cohort') were recruited, and the study has now been visiting this cohort of children for four years. Some areas of interest in GUS are food and nutrition, transition to pre-school, infant weight and height measurements and participation in activities.

Website: www.crfr.ac.uk/gus/

The Infant Feeding Survey (IFS)

The IFS is conducted on behalf of the government health departments in England, Wales, Scotland and Northern Ireland. The survey has been running since 1975 and is repeated every five years with the aim of providing information on breastfeeding and other feeding practices in infants from birth to 9 months. The survey is carried out over a period of 9–12 months to capture feeding practices at different ages. Wave 1 is carried out when infants are aged 4–10 weeks, wave 2 when they are 4–6 months and, finally, wave 3 when they are approximately 8–10 months. A total of 1,666 mothers in Scotland completed and returned all three questionnaires in 2005.

Website: www.ic.nhs.uk/statistics-and-data-collections/health-and-lifestyles-related-surveys/infant-feeding-survey

Information Services Division Scotland (ISD Scotland)

ISD Scotland is part of NHS National Services Scotland, providing support to NHS Scotland and the Scottish Government Health Directorates. It delivers national and specialist intelligence services to improve the health and wellbeing of people in Scotland. Part of its remit is analysis of data collected within NHS Scotland, including data on breastfeeding and neural tube defects.

Website: www.isdscotland.org

The Low Income Diet and Nutrition Survey (LIDNS)

The LIDNS was a cross-sectional survey of residents aged 2 years and older in the 15% most deprived households in the UK and was carried out between November 2003 and January 2005. This survey included an interview, a weighed dietary record on four non-consecutive days, blood samples and anthropometric measurements of participants. Women were excluded if they were pregnant at the time of recruitment. Nutritional intake was assessed by using information about the diet, and nutritional status was assessed using results from the blood samples. The Scottish sample size should be treated with caution as it is very small and will therefore not be adequately representative of the Scottish population as a whole.

LIDNS (women only)	Completed three or four 24-hour dietary questionnaires	Visited by nurse	Blood samples
Scottish sample size in LIDNS	194	134	96
UK sample size	1,850	1,384	951

Website: www.food.gov.uk/science/dietarysurveys/lidnsbranch/

The National Diet and Nutrition Survey (NDNS): Adults aged 19–64 years

The NDNS was a cross-sectional survey of residents aged 19–64 years in Great Britain (GB) living in private households between July 2000 and June 2001. This survey included an interview, a weighed dietary record over a seven-day period, physical activity over the same seven-day period, blood and urine samples and anthropometric measurements of participants. Women were excluded if they were pregnant or breastfeeding at the time of recruitment. Nutritional intake was assessed using information about diet, and nutritional status was assessed using results from the blood samples. The Scottish sample size should be treated with caution as it is very small and will therefore not be adequately representative of the Scottish population as a whole.

NDNS (women only)	Dietary interview	Seven-day weighed intake dietary record	Blood sample
Scottish sample size in NDNS	111	70	–
GB sample size	1243	958	732

– data not reported for Scotland.

A new NDNS is running continuously from 2008 to 2011, and the first-year UK report was published in February 2010. The sample for Scotland has been boosted, but Scottish results will not be available until 2012.

Website: www.food.gov.uk/science/dietarysurveys/ndnsdocuments/

The National Diet and Nutrition Survey (NDNS): Infants aged 1½ to 4½ years

This cross-sectional survey looked at the diet and nutrition of British infants aged between 1½ and 4½ years and was carried out between July 1992 and June 1993. This survey formed part of the NDNS, which was originally set up in 1992. This survey included an interview, a weighed dietary record over four consecutive days (including a Saturday and a Sunday), a record of bowel movements over the same four days, physical measurements of the infant, a blood sample and dental examination.

The report does not tabulate the Scottish sample but states it to be 10% of the overall sample for Great Britain. Again, the Scottish sample size should be treated with caution as it is very small.

NDNS (1½ to 4½ years)	Dietary interview	Four-day weighed intake dietary record	Blood sample
GB sample size	1,859	1,675	1,003

This study is not available online.

Scottish Health Survey (SHeS)

The SHeS was introduced in 1995 to provide a comprehensive picture of the health of the population in Scotland, its biological characteristics, health-related behaviour and the change in these characteristics over time. The SHeS was repeated in 1998 and 2003 and will run continuously from 2008 to 2011. In 2008, 8,215 people participated in the SHeS.

Website: www.scotland.gov.uk/Topics/Statistics/Browse/Health/scottish-health-survey

Southampton Women's Survey (SWS)

From April 1998 to October 2002 the SWS interviewed 12,572 women aged 20–34 years in Southampton. The survey was aimed at assessing dietary and lifestyle factors in women before they became pregnant, then following up any pregnancies within the participants. The survey involved completing a detailed questionnaire, taking physical measurements, a mouthwash sample, blood and urine samples and, finally, a 24-hour food diary. Any participants who became pregnant received ultrasound scans at 11, 19 and 34 weeks of pregnancy and their infants were measured soon after birth. The infants were then followed up at 6 months, 1 year, 2 years, 3 years and 6 years of age. The survey is ongoing, and the next stage will involve assessing the infants at 8 years of age. The survey reports that 3,102 women have had babies since being recruited onto the study.

Website: www.mrc.soton.ac.uk/sws/

Appendix B: Sources of data used in this review from the National Diet and Nutrition Survey and the Low Income Diet and Nutrition Survey

Survey	Volume	Topics	Used in
National Diet and Nutrition Survey: adults aged 19–64 years (NDNS)	1	Types and quantities of foods consumed	n/a
	2	Energy, protein, carbohydrate, fat and alcohol intake	n/a
	3	Vitamin and mineral intake and urinary analytes	Tables 4.1, 4.2, 4.4, 4.5, 4.10, 4.11, 4.14, 4.15
	4	Nutritional status (anthropometry and blood analytes), blood pressure and physical activity	Tables 4.3, 4.6, 4.7, 4.12, 4.13
	5	Summary report	(Appendix A)

Volume 1 Henderson L, Gregory J, Swan G. *National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 1: Types and quantities of foods consumed*. London: The Office for National Statistics, 2002.

Volume 2 Henderson L, Gregory J, Irving K, Swan G. *National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 2: Energy, protein, carbohydrate, fat and alcohol intake.* London: The Office for National Statistics, 2003.

Volume 3 Henderson L, Irving K, Gregory J, *et al. National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 3: Vitamin and mineral intake and urinary analytes*. London: The Office for National Statistics, 2003.

Volume 4 Ruston D, Hoare J, Henderson L, *et al. National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 4: Nutritional status (anthropometry and blood analytes), blood pressure and physical activity*. London: The Office for National Statistics, 2004.

Volume 5 Hoare J, Henderson L, Bates CJ, *et al. National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 5: Summary report*. London: The Office for National Statistics, 2005.

Survey	Volume	Topics	Used in
Low Income Diet and Nutrition Survey (LIDNS)	1	Background, Methods, Sample characteristics	(Appendix A)
	2	Food consumption, Nutrient intake	Tables 4.1, 4.4, 4.10, 4.14
	3	Nutritional status, Physical activity, Economic, social and other factors	Tables 4.3, 4.8, 4.9, 4.12, 4.13

Volume 1 Nelson M, Erens B, Bates B, *et al. Low income diet and nutrition survey. Volume 1: Background, Methods, Sample characteristics*. London: The Stationery Office/Food Standards Agency, 2007.

Volume 2 Nelson M, Erens B, Bates B, *et al. Low income diet and nutrition survey. Volume 2: Food consumption, Nutrient intake.* London: The Stationery Office/Food Standards Agency, 2007.

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