A feasibility study investigating the practical utility of a dietary assessment tool for use with babies and toddlers, and the potential use within Childsmile

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Summary of research

Dental caries is a socially patterned disease, most affecting the lower socio-economic sub-groups of a population. It is thought that prevention of the disease in early childhood can have a long-lasting effect on reducing the risk of caries experience throughout life. One of the risk factors in the aetiology of caries is the amount of sugar-containing foods and drinks consumed, and frequency of intake. Childsmile is an oral health improvement programme for young children living in Scotland, and amongst its other prevention strategies, dietary intervention is considered important to reduce the quantity and frequency of sugar intake in a child's diet, establishing healthy habits, and good dental and general health.

This study aimed to develop and pilot a dietary assessment tool for use in very young children, as a means of monitoring and facilitating dietary behaviour improvement, and/or as an evaluation tool within a research study. A three-day diet diary was developed for parents to collect data on the dietary behaviour of children aged between six and 18 months. It was piloted in Dumfries and Galloway, by 37 families recruited via their health visitor, and visited at their homes by the researcher. Socio-economic, weaning and feeding data were collected by interview. Verbal instructions were given on the process of completing the diary. When collecting the completed diary, a feedback discussion was conducted. Participants were invited to subsequent focus groups to discuss their involvement in the study.

Despite challenges with recruitment, there was a high rate of participant acceptance and compliance. The diaries were completed to a standard of sufficient quality to extract detailed data about feeding habits, allowing identification of behaviours considered of risk in the aetiology of caries. No obvious difference was found in data quality obtained from participants of different socio-economic status (comparing deprivation, education and occupation measures). The diet diary was considered suitable for use in this age-group, with potential use in older children with minor modifications. The practicalities of the diary administration could be incorporated into Childsmile home or dental surgery visits. However, engagement with parents with low literacy levels and those in hard-to-reach subgroups may be more challenging.

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List of abbreviations

ALSPAC Avon Longitudinal Study of Parents and Children

BMI Body Mass Index

CHSP Child Health Surveillance Programme

CI Confidence Interval

DepCat Deprivation category

DHSWs Dental Health Support Workers (Childsmile)

DMFT/ dmft Decayed, Missing and Filled permanent/primary teeth

EDDNs Extended-Duty Dental Nurses (Childsmile)

FFQ Food Frequency Questionnaire

FSA Foods Standards Agency

GUS Growing Up in Scotland study

HBSC Health Behaviour in School-aged Children (WHO report)

IRAS Integrated Research Application System

ISD Information Services Division

MRC Medical Research Council

NDIP National Dental Inspection Programme

NICE National Institute for Health and Clinical Excellence

NHS National Health Service

NMES Non-milk extrinsic sugars

NS-SEC National Statistics socio-economic classification

OHIP Oral Health Impact Profile

OR Odds Ratio

REC Research Ethics Committee

RII Relative Index of Inequality

SDCEP Scottish Dental Clinical Effectiveness Programme

SIMD Scottish Index of Multiple Deprivation

SIGN Scottish Intercollegiate Guidelines Network

SOC Standard Occupation Classification

WISP Weighed Intake analysis Software Package

WHO World Health Organisation

Chapter 1- Introduction

Dental caries in childhood affects 36% of five-year olds in Scotland and is socially patterned, with higher rates of visible decay observed in the most socially deprived children (Macpherson, Conway et al, 2010). The National Dental Inspection Programme of Scotland 2010 reported that 55% of five-year old children living in the most deprived areas had clinical signs of caries experience, compared to 18% of children living in the least deprived areas (Macpherson, Conway et al, 2010). Despite improvements over the last decade, there is still a persisting social gradient with individuals at risk of high numbers of teeth affected by caries concentrated in the most deprived areas (Levin et al, 2009). Risk factors for caries include early colonisation of cariogenic bacteria, poor oral hygiene, low fluoride exposure and frequent intake of sugary food and drink (Harris et al, 2004). Interventions to improve the oral health of children are aimed at addressing these factors by encouraging daily toothbrushing with fluoride-containing toothpaste, providing fluoride varnish application, facilitation of interventions during dental practice attendance and improving diet by health promotion. The Childsmile oral health programme oversees these initiatives across Scotland, aiming not only to reduce caries experience in all, but to reduce inequalities by targeting the most disadvantaged children for more intensive support (Turner et al, 2010).

Peterson (2003) reported that the life course approach appears a useful paradigm for understanding oral health disparities. Experiences in childhood affect the outcomes and choices made in adulthood (Marmot, 2010). Dietary behaviour in children can greatly influence long-term habits, and poor diet can lead to obesity and the associated serious adult health problems, such as cardiovascular disease and diabetes (Cowin et al, 2000; Ebbeling et al, 2002). By addressing underlying common risk factors, improving a child's diet could not only reduce caries experience, but also benefit general health (Sheiham & Watt, 2000). Interventions during early childhood are considered to be most effective, before habitual behaviour has been established (Scottish Government, 2011a). Monitoring diet to assess the impact on general and oral health is clearly important for the evaluation of interventions; however measuring diet in any age group is challenging, and more so in the very young, when food types and portion sizes can vary rapidly during the weaning period. A diet diary method of assessment may be more suitable to collect the level of detail required for this young age group, rather than other established methods used in large population studies (typically food frequency questionnaires).

This study investigates a methodology suitable for recording dietary behaviour in young children, by piloting a diet diary to assess its practical utility across social groups.

Analysis of the data captured by the diet diary aims to investigate how social and family circumstances impact on the dietary behaviour of young children and the adherence to national guidelines.

Chapter 2 - Literature Review

2.1 Literature search strategy

An advanced literature multi-database search was undertaken, using Ovid database, searching in Ovid Medline, Embase, Health Management Information Consortium (HMIC), MIDIRS: Maternity and Infant Care, as well as other databases. The Cochrane library was searched for systematic reviews. Searches were also undertaken in the grey literature such as Google™, Scottish Government, Department of Health and Scottish Dental websites. Suitable papers retrieved had references checked for further relevant literature.

2.2 Dental health of children

2.2.1 Dental caries in childhood

Dental caries, although largely preventable, is still one of the most common chronic diseases of childhood (Gussy et al, 2006). Even in developed countries, dental caries affects 60-90% of school children and the vast majority of adults (Petersen, 2003). In the latest comparable figures available from national epidemiology inspection programmes in 2007/2008, Scotland had a significantly higher prevalence of dental caries experience in five-year old children than England, with 42.3% of five-year old children showing clinical signs of decay experience (Merrett et al, 2008), compared to 30.9% of children in England (British Association for the Study of Community Dentistry, 2009). Scotland's children had a mean dmft (decayed + missing + filled teeth) score of 1.86 (Merrett et al, 2008) compared to a mean dmft in England of 1.11 (British Association for the Study of Community Dentistry, 2009). These comparisons present a significant disparity between the two countries. The Scottish Executive's Action Plan for Oral Health had to re-set the original target that 60% of five-year old children would have no obvious caries experience[1] (dmft=0) by the year 2000, for 2010 (Scottish Executive, 2005). The National Dental Inspection Programme (NDIP) 2010 reported that 64% of five-year old children in Scotland had no obvious caries experience (Macpherson, Conway et al, 2010), rising from 57.7% in 2008. However, for the 36% of children that did have decay experience, the mean number of affected teeth was 4.2, which is of concern.

[1] Obvious caries experience refers to presence of decayed teeth, where caries can been seen to go into the dentine, and/or teeth with pulpal decay, teeth extracted due to decay and filled teeth (Macpherson et al, 2010).

2.2.2 Impact of childhood caries

The way in which dental caries affects a person is perhaps as important as the amount or extent of disease experienced (Nuttall et al, 2006).The immediate problems of childhood caries include pain, infection and distress. MacCormac and Kinirons (1998) reported that, of 177 children, with a mean age of 6.8 years, referred for dental extractions under general anaesthetic in Northern Ireland, 81% had a preceding history of dental pain and 34% reported a history of swelling. Dental caries experience can have a negative impact on quality of life, with adverse effects on interactions and daily activities, sleeping patterns and school attendance (Gift et al, 1992; Peterson, 2003). Poor oral health at a young age can make eating difficult, affecting nutrition, and subsequently growth and development (Arora, Schwarz et al, 2011). Treatment can lead to risks of general anaesthetic, and development of dental anxiety and phobias (Nunn, 2006). Treatment for severe early childhood caries is the primary cause of childhood hospitalisation under general anaesthetic (Palmer et al, 2010), with recurrent caries experience seen in many children. Of the children investigated by MacCormac and Kinirons (1998), previous experience of general anaesthetic for dental extractions was seen in 31% that were undergoing general anaesthetic for the same reason.

Loss of deciduous teeth prematurely can affect development of the permanent occlusion leading to issues of appearance, self-esteem and social confidence. Within the 2003 Children's Dental Health Survey, an oral health impact questionnaire was completed by 3,342 parents of child participants (Nuttall et al, 2006). It was found that the parents of 22% of five-year olds, 26% of eight-year olds, 34% of 12-year olds and 28% of 15-year olds reported their child had been adversely affected by their oral condition in the preceding year (Nuttall et al, 2006). The most frequent impact for all age groups was pain, with impacts on oral function, self-confidence, orally related activity and on the child's emotions experienced by 4-10%. Parents of children with obvious decay in their permanent teeth were significantly more likely to report their child experiencing pain, and had higher reporting of their child avoiding particular orally-related activities, and experiencing an impact on their self confidence, their general health, or having had their life as a whole affected because of their oral condition (Nuttall et al, 2006).

2.2.3 Long term consequences of poor oral health

Oral health in childhood is a predictor of oral health in adulthood. Social and biological factors in very early life influence dental caries levels later in life (Peres et al, 2005), hence poor oral health can not only have an unfavourable effect on childhood but significant impact on later life (Anderson et al, 2004). Health status is determined not

only by clinical indicators, but the impact a disease has on the quality of life of an individual (Gerritsen et al, 2010). Tooth loss due to oral disease (either caries or periodontitis) can lead to impairment of function (chewing and speech) and aesthetic problems, which in turn can impact on the quality of life experienced. A systematic review of the literature by Gerritsen et al (2010) found that tooth loss is negatively associated with oral health-related quality of life, and the strength of this relationship depends on the location and distribution of the missing teeth within the mouth. Missing anterior teeth has a more negative impact on oral health-related quality of life than missing posterior teeth (Walter et al, 2007; Pallegedara & Ekanayake 2008) and the number of retained occluding pairs of teeth is positively associated with oral health-related quality of life (Swoboda et al, 2006; Tsakos et al, 2004). Early caries prevention in childhood to avoid tooth loss during the life course may positively impact on the quality of life experienced by the individual.

2.3 Socio-economic inequalities in health

2.3.1 Social gradient in health

Social and economic differences within society cause a health inequality gradient, which demonstrates that the lower the social status of a person, the worse his or her health (Marmot, 2010). Social inequality in health is a worldwide problem, with higher levels of disease found in more deprived areas (Sisson, 2007), and poorer general and oral health experienced by poorer individuals (Sabbah et al, 2007). The relative index of inequality (RII) is the rate of mortality for the poorest person relative to the richest person in the population (Davey Smith et al, 2002). In England, people living in deprived areas have a shorter life expectancy by seven years and a shorter disability-free life expectancy by 17 years, than people living in affluent areas (Marmot, 2010). Davey Smith et al (2002) reported that the RII for mortality in Britain increased steadily from 1990 to 1999, particularly in the latter half of this decade, and this trend paralleled the increase in income inequality seen across the country. Inequalities due to social and economical factors are influenced by social position, which in turn is shaped by income, education, occupation, gender, ethnicity and race (Marmot, 2010).

2.3.2 Explanations of social inequalities in health

The differences in health, well being and life expectancy caused by socio-economic differences are avoidable (Marmot, 2010). In early childhood, there is the potential to affect the life course of an individual, in order to reduce inequalities experienced. The life course perspective theory explains how social inequalities in health result from the interaction of materialist, behavioural and psychosocial factors over time (Sisson, 2007). In this way, the life course perspective encompasses more established explanations. In reference to dental health, the materialist explanation considers how material costs limit poorer individuals and families from accessing dental services (both the costs of the treatment and the access to treatment) and from purchasing health providing products and foods (Sisson, 2007). The behavioural explanation suggests that individuals from low socio-economic backgrounds are more likely to engage in health-damaging behaviours, which are not freely chosen but influenced by cultural norms which differ between social groups (Sisson, 2007). The psychological perspective explains that health inequalities may result from the higher levels of psychological stress experienced by individuals from lower socio-economic backgrounds, due to living, work and social circumstances. This can directly reduce a body’s resistance to disease, or indirectly influence a person to make health-damaging lifestyle choices (Sisson, 2007). Davey Smith et al (2002) reported that the increase in RII for mortality seen in the 1990s was

particularly dramatic for young adults (20-44 years), men especially. If inequalities in health are being determined across a life course, this suggests that even by early adulthood the shortfall of life expectancy in the poorest individuals is established. Healthcare interventions need to be introduced from early childhood in order to prevent socio-economic circumstances determining a life course for an individual, which has detrimental impacts on their health.

2.3.3 Measures of socio-economic position

Epidemiological studies have used individual-based variables such as occupation (Mason et al, 2006), education level and poverty income ratio (Sabbah et al, 2007) to measure socio-economic status. The Scottish Index of Multiple Deprivation (SIMD) is an area-based measure and incorporates these variables in a postcode-based scale, using 37 indicators of deprivation in seven domains, for a small population area (with a median of 769 people), classified as a data zone. The seven domains assessed are income, employment, education, housing, health, crime and geographical access (Scottish Government, 2010a). The combined ranking of these factors creates the index of multiple deprivation in all areas throughout Scotland. Data zones are ranked from most deprived (1) to least deprived (6,505) on the overall SIMD. The full index of data zones can be separated into quintiles, which are percentiles divided into fifths (20^{th}, 40^{th}, 60^{th} and 80^{th} percentiles), deciles (dividing percentiles into tenths) or vigintiles (dividing percentiles into twentieths).

2.3.4 Effect of social and geographical inequality on child dental health

There is a direct relationship between low socio-economic status and childhood caries experience (Nunn, 2006). Whilst Levin et al (2009) report that the prevalence of childhood caries in Scotland has decreased over time, inequalities between the affluent and deprived have persisted, with individuals at risk of high numbers of teeth affected by caries concentrated in the most deprived areas. The 2010 NDIP report (Macpherson, Conway et al, 2010) showed that while 78.7% of five-year old children in the most affluent areas (SIMD quintile 5) had no obvious caries experience, this was true for only 46.5% of children living in the most deprived areas (SIMD quintile 1). McMahon et al (2010) investigated the dental health of 2,797 three-year old children in greater Glasgow in 2007/2008, and even at this young age, the prevalence of dental caries was high, with 25% of children experiencing some decay into the dentine or beyond. The mean dmft was lower in the least deprived areas (0.5 in SIMD Q5) compared to the most deprived areas (1.4 in SIMD Q1), with an odds-ratio for caries experience in the most

deprived children compared to children in the least deprived areas of 2.90 [95% CI= 2.31, 3.64], p<0.001 (McMahon et al, 2010). This highlights the social gradient which exists in terms of dental disease in children and the need for healthcare interventions targeting the most socially deprived, from a young age.

Across Scotland, there is geographical variation in the level of caries experienced, with the 2010 NDIP reporting that whilst 12 of the 14 health boards reached the target of 60% of five-year old children with no obvious decay experience, there was a difference of over 20% between health boards (Macpherson, Conway et al, 2010). The mean dmft seen in Greater Glasgow and Clyde is approximately twice as great as the Borders health board, and at the individual child level, there was a range from one to 20 teeth affected by decay (Macpherson, Conway et al, 2010). Specifically, within one health board in particular, Dumfries and Galloway, whilst the target was reached, with 65.8% of five-year olds having no obvious decay experience; of the 34.2% affected by caries, the mean dmft was 4.63, the worst out of all the health boards in Scotland (Macpherson, Conway et al, 2010).

2.3.5 Deprivation in Dumfries and Galloway

Dumfries and Galloway, a rural region of South Scotland, has a population of 148,300 (Scottish Neighbourhood Statistics, 2007), with an average of 61.8 people per square mile. Seventeen percent of the population are children. As a whole, Dumfries and Galloway has lower levels of deprivation than many urban areas of Scotland. However, there are still pockets of deprivation and measurable differences in the levels of morbidity and mortality between the top and bottom scoring neighbourhoods. The Scottish Index of Multiple Deprivation 2009 General Report (Scottish Government, 2009) showed that of the 193 data zones in Dumfries and Galloway, 11 are in the bottom 15% of the most health deprived data zones in Scotland. This is equivalent to a 1.1% share of all the worst areas in Scotland. Using the General Register Office for Scotland Population Estimates for 2004 at the Dumfries and Galloway level, Allan and Bruce (2007) calculated that 12,238 people live in the 16 most deprived data zones (which are within the 20% most deprived zones in Scotland, classified as SIMD quintile 1). This is 8.3% of the regional population. This is significantly less than the national figure for Scotland (19.7% of the population in the 20% most deprived areas). The urban central Dumfries locality has seven of the 16 most deprived areas, five in North West Dumfries and two in the Loreburn area. Each of these zones has approximately 750 residents.

2.3.6 Limitations of deprivation measures

Area-based measures of deprivation can be of limited value in a rural region, such as Dumfries and Galloway. SIMD classifications assume that residence in a deprived area indicates individual deprivation, and conversely that living in a non-deprived area eliminates potential of individual deprivation (Turner et al, 2010). Carnon and Allan (2006) discovered that the large majority of income or employment-deprived individuals in the region live in areas that are not recognised as deprived. The two most deprived quintiles of SIMD only account for half the income or employment deprived individuals. This demonstrates the difficulty in identifying people experiencing deprivation, and the direction of health initiatives aimed to tackle the inequalities caused and exacerbated by deprivation. The paper by the Directorate of Public Health and Strategic Planning of NHS Dumfries and Galloway (Allan & Bruce, 2007) details the significant effect of deprivation gradient on health inequalities in Dumfries and Galloway.

2.3.7 Effect of socio-economic inequality in childhood on adult dental health

Inequalities in health may develop over a life course due to accumulation of risk factors caused by exposure to disadvantage, particularly during early childhood (Sisson, 2007). Action to address the relationship between socio-economic status in childhood and child dental health should, in turn impact positively on adult oral health (Nunn, 2006). Mason et al (2006) examined the life course perspective by recruiting 305 men and women aged 50 years, who as young children, with their families, took part in a socio-economic status determination study. When predictors of oral health-related quality of life were examined for men, social class at birth had the most significant association with the oral health impact profile (OHIP) score given (Mason et al, 2006). For women, the number of retained teeth showed the most significant relationship with total OHIP score. Early-life factors (social class at birth and five years, housing conditions) accounted for the greatest proportion of variation in the number of OHIP impacts occurring ‘fairly or very often’, especially in men (Mason et al, 2006). Adult socio-economic position had a lesser effect, accounting for the greatest variation in OHIP impacts occurring ‘occasionally or more’. These results show that life course influences may have a significantly different effect on the oral-health-related quality of life seen by men and women. Yet, for both genders, social background is important in determining the clinical and subjective measures of oral health in later life (Sabbah et al, 2007). Thompson et al (2004) examined 789 people at age five and 26 years in a longitudinal cohort study. Those of low socioeconomic status at five years were at a significantly greater risk of having caries and periodontal disease in adulthood. When

controlling for socio-economic factors, it was found that high caries levels at five years was associated with oral disease at 26 years. Childhood socio-economic position and oral health status can both predict adult oral health (Thompson et al, 2004). Therefore, when assessing the results from the study by Mason et al (2006), and assuming that teeth have been lost due to poor oral health, it can be postulated that, directly (with men) and indirectly (with women), childhood socio-economic factors have significant impact on the oral-health related quality of life experienced in adulthood.

2.3.8 Common risk factor approach

As the risk factors associated with different health problems often overlap, there is validity to the common risk factor approach of directing health promotion at underlying determinants (Sheiham & Watt, 2000). This approach aims to have an impact on a large number of diseases by improving health: reducing risks, promoting health, facilitating behaviour change and creating supportive environments (World Health Organisation (WHO), 1986). Not only does this methodology avoid duplication, reduce isolation, increase effectiveness and efficiency of health promotion services, it focuses on improving general health for the whole population. The groups with the greatest burdens of all diseases are the deprived and socially excluded (Sheiham & Watt, 2000), and so the common risk factor approach aims to be of most benefit to these groups, by raising health standards, thereby reducing inequalities. Proportionate universalism aims to reduce the steepness of social gradient in health by providing more support to those with greatest need, and requires action across all social determinants of health, but in turn should benefit all aspects of health (Marmot, 2010).

2.3.9 Action to address inequalities

Healthcare actions need to be directed to reduce the steepness of the social gradient of health, by universal actions, but with a scale and intensity proportional to the level of disadvantage (Marmot, 2010). The highest priority recommendation of the Department of Health commissioned strategic review of health inequalities in England post-2010, was that every child should be given the best start in life (Marmot, 2010). The policy recommendations advised by the review included increasing the expenditure allocated to the early years (under five year-olds) and ensuring that it is focused progressively across the social gradient (Marmot, 2010). Similarly the Scottish Government's National Performance Framework's main outcomes are that "our children have the best possible start in life and are ready to succeed", in order to "lead longer, healthier lives" (Scottish Government, 2011a). Recent policy, including the Early Years Framework, aim

to target support to those in need to ensure that health outcomes for children are maximised and health inequalities are reduced (Scottish Government, 2008b).

Another key recommendation from the Marmot review (2010) is the prioritising of investment in ill health prevention and good health promotion, particularly in the early years, to prevent ill health in later life. Marmot (2010) reported that only four percent of NHS funding is currently allocated to prevention, despite the holistic benefit of universal and targeted preventive interventions. Promoting awareness of the underlying social determinants of health inequalities can lead to an appreciation of the need to fund evidence-based interventions, and to assess the impact of these on the goals of health equality and a fairer society (Marmot, 2010).

2.4 Risk factors for childhood caries

Caries is caused by the fermentation of carbohydrate by plaque bacteria in the mouth, producing acid which leads to demineralisation of the tooth surface. It is preventable by the reduction of harmful bacteria and/or their food source to acceptable levels in the mouth, so as to prevent net demineralisation of tooth enamel. Action to promote the reduction of these risk factors should in turn reduce the level of experience of dental caries.

2.4.1 Early colonisation of cariogenic bacteria

The mouth needs to be colonised by cariogenic bacteria for the disease process leading to dental caries to be initiated. Colonisation is thought to happen by transmission from parents to their infant, with *mutans streptococci* being implicated as the main microbiological risk factor. A systematic review of the literature by Harris et al (2004), found 106 risk factors associated with the development of caries in deciduous teeth of children aged six years and under, with the evidence suggesting that children who had oral colonisation of *S. mutans* at an early age most likely to develop caries. A more recent systematic review of literature confirmed that *S. mutans* levels are a strong risk indicator for early childhood caries (Parisotto et al, 2010).

Examination of *S. mutans* colonisation can be accurately and easily conducted in studies involving young children (Habibian et al, 2002; Linossier et al, 2003; Tankkunnasombut et al, 2009). Mohan et al (1998) reported that 20% of children under 14 months of age were found to have oral colonisation of *S. mutans*, implying a large proportion of children are at risk of developing dental caries from a very young age. Similar findings were reported from a study of 202 Thai children, with *S. mutans* colonisation found in infants as young as two months old, and 5% of predentate children having *S. mutans* detected on oral saliva swabs (Tankkunnasombut et al, 2009). Twenty-six percent of the children, aged from two months to 36 months (mean age of 20.5 months), were found to have *S. mutans* colonisation, which increased significantly with age and number of teeth erupted ($p<0.001$) (Tankkunnasombut et al, 2009).

Boyce et al (2010) reported that low family socio-economic status is associated with higher counts of oral cariogenic bacteria in five to six year old children, and both factors are associated with higher risk of dental caries. Early social conditions may influence early colonisation of cariogenic bacteria to initiate disparities in dental health (Boyce et al, 2010). Wan et al (2001) reported evidence that colonisation of *S. mutans* is more likely in infants where there is greater contact with adults' saliva (sucking fingers,

sharing of food and utensils and having food pre-tasted). In addition, infants colonised with *S. mutans* were more likely to have a mother with higher levels of *S. mutans*, more plaque and calculus present, more periodontal disease, and who brushed their teeth less frequently (Wan et al, 2001). These factors all lead to the greater likelihood of transmission of *S. mutans* from mother to infant. Therefore promotion of good oral hygiene to expectant mothers, as well as advice to reduce transmission methods of saliva to their child, could help reduce early transmission rates.

2.4.2 Oral hygiene

Frequency of toothbrushing is a risk factor for dental caries (Levin & Currie, 2009), and it is recommended that children brush their teeth at least twice daily (Scottish Executive, 2002). The national survey of Children's Dental Health in the United Kingdom, 2003, reported that more than three-quarters of children aged between five and 15 years brush their teeth at least twice a day (Office for National Statistics, 2005). Similarly in Scotland, 74% of children aged 11-15 years of age report brushing their teeth at least twice a day (Currie et al, 2010). This is higher in girls than boys (81% compared to 66%). There is little difference in toothbrushing at 11 years compared to 15 years (Currie et al, 2010), which confirms the importance of establishment of good oral hygiene habits early in life (Kuusela et al, 1996). Toothbrushing at least twice a day is more likely in individuals with a higher family socio-economic status (Levin & Currie, 2009), and eating breakfast is reported to be a strong predictor for toothbrushing (Levin & Currie, 2010). Masson et al (2010) reporting on the results of the 2006 survey of sugar intake among children in Scotland, found that children in the least deprived SIMD quintile were more likely to report brushing their teeth frequently (80%) compared with children in the least deprived quintile (55%).

Presence of gingivitis and plaque is an indicator of poor toothbrushing technique, and perhaps a more accurate measure of toothbrushing habits than self-reporting. The survey of Children's Dental Health in the UK, 2003 (Office for National Statistics, 2005), found no statistically significant differences in plaque scores between children attending deprived or non-deprived schools. There was no difference between deprived and non-deprived schools in the proportion of 15-year-olds with gingivitis (43% in both). There was no clear relationship between individual socio-economic status (based on occupation background of the household) and gum inflammation, calculus or gingivitis for any age group from five to 15-year olds (Office for National Statistics, 2005). It is difficult to compare studies using different measures of socio-economic status to draw collective conclusions, but this research would suggest that toothbrushing habits do not play a significant role in explaining the socio-economic inequalities of decay experience

observed in children. However, the role of fluoride and its delivery via toothpaste was not considered.

2.4.3 Exposure to fluoride

Fluoride prevents dental caries, by controlling the initiation and progression of lesions, by both its topical and systemic use (Marinho et al, 2004). The WHO recognises how long-term exposure to an optimal level of fluoride can result in diminishing levels of caries in both child and adult populations (Peterson, 2003). Its main actions are the prevention of demineralisation of sound enamel and remineralisation of early caries. There are topically-applied fluoride delivery vehicles, including fluoride-containing toothpaste, mouthrinses, gels and varnishes, as well as methods of increasing fluoride exposure through systemic effects, such as fluoridation of salt or public water supplies (Peterson, 2003). Systematic reviews of the literature found that the relative preventive effects of fluoride toothpastes of different concentrations increase with higher fluoride concentration (Walsh et al, 2010) and that children who used another form of topical fluoride in addition to fluoride toothpaste experienced some additional reduction in caries experience compared with children who only used fluoride toothpaste (Marinho et al, 2004; Arzapazhooh & Main, 2008). Debate on the appropriate use of fluorides, due to the potential risk of fluorosis (enamel mottling), have led to healthcare interventions using topically-applied fluorides, particularly directed at high-risk groups, rather than interventions such as public water fluoridation (Marinho et al, 2004).

2.4.4 Prolonged breastfeeding

The theory that prolonged and on-demand breastfeeding is a causative factor in the development of early childhood caries remains controversial. Recent evidence for a negative impact of prolonged breastfeeding on dental health has shown the risk of rampant childhood caries increasing by 10% with every month increase in the duration of breastfeeding (Folayan et al, 2010). However, earlier systematic reviews of the literature (Valataitis et al 2000; White, 2008) showed no evidence of an independent association between breastfeeding or its duration and an increased risk of early childhood caries.

2.4.5 Sugar-rich diets

Diets rich in sugars play a major role in the aetiology of dental caries (Peterson, 2003), with both amount and frequency of sugar intake being of concern (Moynihan, 2002).

2.4.5.1 Types of sugars

Sugar is a simple carbohydrate that exists either as a single molecule monosaccharide (such as the types: glucose, galactose and fructose) or as a linked double molecule disaccharide (such as sucrose, lactose and maltrose). Sucrose is composed of glucose and fructose and is the major sugar in most diets. It occurs naturally in fruit, vegetables, honey and maple syrup. It is also purified from sugar beet and cane to be used as an important food ingredient in biscuits, cakes, desserts, confectionery, ice cream and soft drinks (Gray, 2003). Other than soft drinks, these foods also contain lactose, a sugar composed of glucose and galactose, which occurs naturally in milk and dairy products, often important ingredients in baked goods.

2.4.5.2 Non-milk extrinsic sugars

Non-milk extrinsic sugars (NMES) is a classification referring to all free sugars (not contained within the cells of the food) other than those naturally present in milk and whole fruit and vegetables (Ruxton et al, 2010). Therefore NMES includes fruit juices, honey and 'added sugars', which comprise of both recipe sugars and table sugars. Extrinsic sugars are more readily metabolised by oral bacteria than intrinsic sugars integrated within cells and milk sugars (Moynihan, 2002), and so are potentially more cariogenic. Excessive NMES consumption is implicated as a key causative factor in a range of adverse health conditions, including dental caries, obesity and diabetes (Ruxton et al, 2010). This led to the recommendation that for the UK population, no more than 11% of food energy should be derived from NMES (Department of Health, 1991). However, a systematic review of the evidence 1995- 2006, showed a mixed picture, with no clear associations between NMES and the implicated health problems, and called for more high quality evidence to determine whether quantitative populations targets for sugar intake have the potential to improve health (Ruxton et al, 2010).

A recent survey of sugar intake among children in Scotland conducted by the Foods Standards Agency (Sheehy et al, 2008) assessed the diet of 1398 children aged three to 17 years using semi-quantitative food frequency questionnaires. It reported findings that increasing socio-economic deprivation was associated with self-reported treatment for dental decay in both sexes, and children who had received treatment for decay had significantly higher intakes of NMES, such as those found in biscuits, cakes, confectionery and soft drinks. A recent study in the USA, of 110 children aged two to six years, used 24 hour recall surveys to compare diet with clinical examination for caries (Palmer et al, 2010). There were no differences in age, gender, race, family income or

parent education between children presenting with severe early childhood caries and those considered caries free. Reported daily use of fluoride toothpaste also did not differ, and all the children lived in water-fluoridated areas. The study reported that sugar in liquids (juice, ice cream, sweetened yoghurt, soda) and retentive solids (such as jam/jelly, cookies, sweetened cereal, potato chips) were both significantly associated with caries experience. Estimated food or drink cariogenicity was determined for each child by placing items consumed into one of five categories based on potential cariogenic risk, then dividing the weighted sum of items in each category by total items consumed. It was found that food or drink cariogenicity was significantly higher in children with severe early childhood caries than caries-free children ($p<0.0001$) (Palmer et al, 2010).

2.4.6 Timing of sugar consumption

Anderson et al (2009) conducted an extensive systematic review of the literature to determine the relationship between dental caries and sugar consumption. Few papers met the stringent criteria for inclusion, with some landmark studies (Gustaffson et al, 1954; Harris, 1963; Fisher, 1968) considered of insufficient quality to be included in the review. Only 31 studies from 1856 to 2007 fulfilled the necessary criteria, and the analysis of these showed that whilst only six papers showed a positive significant association between sugar quantity and dental caries, there was greater evidence of an association between frequency of sugar consumption and caries with 19 studies supporting this. The cariogenicity of sugar/starch containing foods is higher when consumed frequently (as snacks) than with meals, with caries prevalence more affected by the frequency, timing and nature of sugar events than the sugar's categorisation (Marshall, Eichenberger-Gilmore, Larson et al, 2007). Snack foods eaten by children account for a large percentage of their daily NMES intake, with Macdiarmid et al (2009) reporting that children who have frequent snacks have higher daily intake of NMES (study details discussed in section 2.6.3.2), and so it is difficult to separate the two factors of NMES intake and frequency of intake to consider independently. The increased number of eating events per day, combined with the high amount of NMES at these events, synergistically gives children who snack frequently a greater risk of developing dental caries (Scottish Intercollegiate Guidelines Network, 2000). The study by Palmer et al (2010) showed significant associations with frequency of intake and caries. More children with severe early childhood caries drank juice, particularly between meals, than caries-free children ($p<0.007$) and consumed more food and drink items a day ($p<0.0029$) and more frequently ($p<0.0002$) than caries free children, including bedtime snacks ($p<0.002$). Similarly, Touger-Decker & Mobley (2007) found that in younger children, a combination of infant feeding practices and repeated

sequential consumption of fermentable carbohydrates, such as sweetened drinks or highly processed starchy/sugary foods increases caries risk.

2.4.7 Other snack foods

Carbohydrate-rich starchy foods, such as crisps, are frequently eaten as snacks. These types of energy-dense, low nutrient content foods may not have a high NMES content, but could have cariogenic potential. Animal studies have shown that whilst some crisps have low cariogenicity, depending on the processing and nature of flavouring agents added, certain crisps and similar snacks had a cariogenic potential not far short of semi-sweet biscuits (Grenby, 1990). Maliderou et al (2006) studied three-day diet diaries completed by 60 children aged five to 16 years in London, and reported correlations between the consumption of crisps with the number of decayed, missing or filled teeth ($p<0.05$), and with social class ($p<0.05$). Masson et al (2010) reporting on the survey of sugar intake among children in Scotland, found that although crisps and savoury snacks contributed less than 1% to NMES intake, children with the medium or highest intake of these food items were at significantly raised risk of having had treatment for decay compared with those with the lowest intake ($p=0.006$). Sticky, chewy foods that leave residue on teeth surfaces can prolong exposure to carbohydrate and lower oral pH, which if often combined with rich sources of NMES, can potentiate caries. Masson et al (2010) reported an association between consumption of crisps and savoury snacks and consumption of non-diet soft drinks ($p<0.001$). A US study of 1,206 children under four years of age (Johansson et al, 2010) reported that caries was significantly more prevalent among children who ate crisps most days, with a higher mean dmft score in these children. It was found that children given crisps as a snack most days also had a high intake of sweet snacks, ice cream and sweets, showing a clustering of unfavourable dietary behaviours, with the suggestion that starch may increase the cariogenic effect of sucrose (Riberio et al, 2005).

2.4.8 Relationship between early colonisation of cariogenic bacteria, NMES and oral hygiene

Interactions of diet and oral hygiene can affect the oral environment to encourage or inhibit the bacteria's cariogenic activity. Oral microorganisms, especially *S. mutans* adhere to tooth surfaces in the sticky plaque matrix formed from dietary sucrose. Removal of the plaque through good oral hygiene and reduced dietary sugar intake are independently associated with lower levels of *S. mutans* in the mouth. Habibian et al (2002) conducted a UK study investigating infant toothbrushing, and found only 3% of children whose parents had started brushing their teeth by 12 months had detectable *S.*

mutans, compared with 19% who did not have their teeth brushed before 12 months (p=0.003), with no association observed between any socio-economic factor and the detection of *S. mutans*. Similarly, the mean daily frequency of eating/drinking events at 12 months and the levels of *S. mutans* in plaque had a significant positive correlation (Spearman's rank correlation co-efficient r_s=0.4, p<0.001).

Colonisation by cariogenic bacteria is more likely in young children who have more frequent episodes of NMES per day, even before tooth eruption. Wan et al (2001) conducted a study of 172 predentate infants in Australia, reporting high levels (60% of full-term and 50% of pre-term infants) of colonisation with *S. mutans*, shown by repeat sampling. Those with *S. mutans* colonisation had higher daily sugar frequencies (p<0.001), with increased night feedings, and were less likely to have their gums cleaned daily (p<0.05). Habibian et al (2002) reported a low correlation (r_s= 0.15) between the mean daily frequency of consumption of food and drinks containing NMES and the levels of *S. mutans* detected in children of 12 months of age (p=0.05), and that the mean frequency of consumption of NMES by children with detectable *S. mutans* was five times per day, compared with 3.9 times a day by children with no detectable *S. mutans* (p=0.04).

Mohan et al (1998) found that children who consumed sweetened drinks in their baby bottles had a four-fold increase (OR=4.0; 95% CI=1.2-12.6) in the odds of oral colonisation by *S. mutans* than children whose bottles contained milk. Nainar and Mohummed (2004) reviewed evidence that similarly showed how consumption of sweetened drinks by infants from the ages of six weeks to 24 months increased the chance of cariogenic bacterial colonisation, and a significant increase in the caries experience of these children at five years of age.

2.5 Other health problems associated with nutrition

It is believed that a child's nutritional status has a significant impact on their present and future health. The effects of a poor diet in young age groups are perhaps most easily observed in terms of dental health, but also are associated with the increasing public health problem of childhood obesity. Recent evidence suggests that many toddlers in the United Kingdom do not consume a diet that provides an adequate nutritional balance (Shepherd, 2008) and the levels of obesity and related health problems in this group are increasing. Dietary nourishment during infancy affects a baby's response when exposed to infection during early childhood, and might influence disease he or she will develop in later life (Barker, 1998). Also, the pattern of infant feeding may be relevant to the development of childhood obesity, which in turn is related to adult obesity (de Bruin et al, 1996). The need for improving the Scottish diet is clear, as Scotland, like other industrialised nations, faces an epidemic of obesity and many linked secondary conditions (Scottish Executive, 2003). An approach aimed at improving the nutritional status of preschool children may not only reduce NMES consumption and hence improve oral health, but may also improve the overall quality of pre-school children's diet and thereby promote their growth and development (Sheiham & Watt, 2000).

2.5.1 Evidence of association of dental caries and childhood obesity

Low socio-economic status increases the risk of both caries and obesity, and may be responsible for the existence of both in this vulnerable group of the population. Public health measures designed to modify dietary behaviour could have positive action on both of these childhood health burdens, and hence the long-term adult health consequences displayed by both (Marshall, Eichenberger-Gilmore, Broffitt et al, 2007; Touger-Decker & Mobley, 2007).

Dietary behaviour is often perceived as a common underlying causative factor in both these disease processes. However a systematic review by Kantovitz et al (2006) found only three studies had high levels of evidence regarding this relationship, with only one showing a direct association between dental caries and obesity. Since then, large scale studies have shown statistically significant associations between body mass index (BMI) and the prevalence of dental caries in both the deciduous and permanent dentition (Willershausen et al, 2007; Sharma & Hedge, 2009; Vazquez-Nava et al, 2010), and conversely, no significant association between obesity and caries experience (Hong et al, 2008; Tramini et al, 2009). This disparity between studies could be partly due to the

difficulty in assessing dmft and DMFT in children who are at an age of moving from the deciduous to the permanent dentition, and the wide variable age range over which this occurs. Sanchez-Perez et al (2010) found that at aged 11 years, children with higher BMI had more erupted teeth ($p < 0.001$), as well as lower caries experience than children with lower BMI.

2.5.2 Prevalence of childhood obesity

The prevalence of obesity in childhood (classified as two to 15 year olds) is increasing rapidly, with values in England in 2007 of 17% among boys and 16% among girls (Reilly et al, 2009), and combined rates for overweight and obesity of 31% for boys and 29% for girls in 2010 (NHS Information Centre, 2010). NHS Scotland conducts a large-scale Child Health Surveillance Programme (CHSP), which collects BMI statistics for approximately 71% of children in Primary 1 class (five years of age) (ISD Scotland, 2010). In 2009/2010, among the ten participating health boards in Scotland, it was found that 20.4% of Primary 1 children were classified as overweight, with 8.2% termed obese and 4.1% severely obese. 3.1% were classified underweight (ISD Scotland, 2010).

2.5.3 Childhood obesity linked to adult obesity

Reilly et al (2003) reported that childhood obesity predicted adult obesity in 40-70% of children, potentially with associated risks to adult health. Systematic reviews of the literature have shown there is a positive association between rapid weight gain during infancy and the prevalence of obesity in later life (Baird et al, 2005; Monteiro & Victora, 2005).

2.5.4 Long term consequences of childhood obesity

Poor diet contributes to a range of serious long-term illnesses, which include coronary heart disease, certain cancers, strokes, type II diabetes and musculoskeletal problems such as osteoporosis (Ebbeling et al, 2002). High blood pressure and cholesterol levels, leading to hypertension and atherosclerosis, have been shown to develop from very early in life (Cowin et al, 2000). Obesity in childhood is not only linked to the development of immediate conditions, such as asthma and type II diabetes, but also increased middle-age mortality and morbidity, irrespective of adult weight status (Stamatakis et al, 2005).

2.5.5 Social inequalities affecting obesity

Socio-economic factors can lead to inequalities in health outcomes, as well as access to healthcare services (Shaw et al, 2009). Poor nutritional status is a specific cause of higher rates of ill health in low income households (Holmes et al, 2007). Higher numbers of overweight and obese individuals are found in areas of deprivation, low-income households and lower socio-economic groups (Pearce et al, 2008), and the greatest increase in obesity levels has been seen among children from lower income families. Data from both the CHSP and the 2003 Scottish Health Survey found that deprivation is strongly associated with obesity in children at pre- and school age, with a steady increase in the prevalence of obesity from lowest in the SIMD least deprived quintile (5) to highest in the most deprived quintile (1) for all year groups (Grant et al, Scottish Public Health Observatory, 2007). Social and parental indicators of deprivation are closely related to the development of obesity in childhood (Stamatakis et al, 2005). Public health interventions need to address the increasing obesity rates in early childhood, particularly targeting children from lower socio-economic backgrounds, who are most at risk of exposure to unhealthy behaviours (Campbell et al, 2008, Drieskens et al, 2009).

2.6 Dietary recommendations and current behaviours

2.6.1 When to wean?

Since 2001, WHO has recommended that infants should be exclusively breast fed for six months (WHO, 2001), although the 2005 National Infant Feeding Survey reported that this happens for less than 1% of UK infants (Bolling et al, 2007). In fact, the survey found that only 25% of infants were still being breastfed at six months of age, despite WHO recommending breastfeeding to continue in addition to appropriate complementary foods for up to two years and beyond (Pan American Health Organisation, 2003). Scottish Government policy (2011a) echoes WHO's recommendations, however national data from approximately 90% of births in Scotland in 2009 showed that after birth, only 56% of mothers reported exclusively breastfeeding, and this decreased to 27% at the six-eight week review with a public health nurse (Flanagan & Gordon, 2010). Maternal deprivation has a close negative association with breastfeeding rates (Flanagan & Gordon, 2011), and the Infant Feeding Survey 2005 reported that babies living in the least deprived areas are almost twice as likely to have been breastfed (77%) than infants in the most deprived areas (44%) (Bolling et al, 2007).

Whilst there is no dispute that breast milk is recommended over formula milk, it is now postulated that, in developed nations, six months of exclusive breastfeeding may not always support an infant's energy requirements, and not provide adequate nutrition for optimal growth and development (European Food Safety Authority, 2009). Introduction of complementary feeding between four and six months is now deemed suitable, dependent on the individual infant, and could reduce the incidence of food allergies, coeliac disease, and anaemia (Fewtrell et al, 2011). Early introduction of solid foods has been linked to increased weight gain in infancy (Sloan et al, 2008), increased fatness in childhood, and the risk of health problems in later life, particularly obesity, cardiovascular disease and diabetes mellitus (European Food Safety Authority, 2009; Fewtrell et al, 2011).

The Scottish Government (2011a) still advises that weaning begins around six months of age. However, the Infant Feeding Survey 2005, reported that 60% of mothers in Scotland had introduced solid foods by four months (Bolling et al, 2007). Prior to the WHO 2001 guideline on exclusive breastfeeding till six months, the UK Department of Health (1994) advised weaning to begin between four and six months, and so the 2005 data was an improvement on previous years (83% of mothers had introduced solid foods by four months in 2000) but there is no data that is more recent to determine a shift of later timing of weaning in line with current guidelines (Flanagan & Gordon, 2011).

2.6.2 Healthy weaning diet

It is not widely understood what constitutes an optimal diet in infancy and there appears to be relatively few studies of weaning practice in the UK (Robinson et al, 2007). Picciano et al (2000) also report of the lack of representative data about the nutritional patterns of children during the time of rapid dietary transition following weaning. A recent review by the Public Health Observatory Division at NHS Health Scotland (Flanagan & Gordon, 2010) aiming to describe what is known about current maternal and infant nutrition in Scotland, found limited data available, with no Scottish data on the diet and nutrition of infants following weaning onto solid foods up to the age of three years.

A weaning diet should provide the nutritional requirements for a growing child and contain a variety of foods and drinks, as this is a sensitive period for exposure to new tastes and food textures (Harris, 2008). Early food acceptance is promoted by social influences and can be modified by behaviour modelling and conditioning, with learned food preferences in infancy and childhood continued into adulthood (Addessi et al, 2005). Therefore, a healthy diet needs to be established from birth.

2.6.2.1 Maternal nutrition

The diet and nutritional status of the mother during pregnancy can affect the long term health of the child (Scottish Government, 2011a). Nutrition during pregnancy is thought to provide developing infants with an insight into the level of nutrition they will receive when they are born (Flanagan & Gordon, 2010). Flavour learning can begin very early in life, by maternal transmission during pregnancy and then breastfeeding (Menella et al, 2005; Venter & Harris, 2009). It is therefore important to improve maternal health in order to optimise the nutritional status of their child (Scottish Government, 2011a).

2.6.2.2 Development of food preferences and repeated exposure

Early exposure to a variety of tastes and textures is important in the long term development of children's food preferences (Scottish Government, 2011a). With continued exposure, foods that an infant seems to dislike initially can become acceptable (Maier et al, 2007), particularly if during the age of four to six months. Both breastfeeding and daily changes of the vegetables offered to an infant in this early period of weaning increases the accepted intake of new foods for at least up to two months, and the two factors are complementary (Maier et al, 2008). The texture of food also aids acceptance, and again is dependent on exposure (Venter & Harris, 2009). The later the exposure of solid, lumpy foods (after 10 months compared to after six months)

the more feeding difficulties, choosiness and food refusal at 15 months (Northstone et al, 2001) and the more feeding problems and poorer acceptance of a range of fruit and vegetables at seven years of age (Coulthard et al, 2009). Early introduction of a range of foods has a positive effect on later food acceptance (Russell & Worsley, 2008). Repeated exposure to healthier foods at an early age has been shown to increase the health rewards associated with their consumption (Parkes & Wight, 2011). Also, the increasing of portion sizes of a vegetable in a meal has been found to effectively increase vegetable consumption in preschool children (Spill et al, 2010). Identifying and modifying inappropriate health behaviours early in life may not only contribute to habitual behaviour change, but also might reduce the negative long-term impact of exposure to poor nutritional practices.

2.6.2.3 Modelling behaviour

The presentation of foods to a child in a positive or negative context can influence diet (Crombie et al, 2008). Toddlers are more likely to accept new foods that are eaten by the whole family, and if they see an adult eating it at the same time (Addessi et al, 2005). However, unless the family is eating healthy food, modelling can also have a negative impact on diet. The Infant and Toddler Forum (2009) online survey reported that 29% of under three year-olds were fed takeaways at least once a week and 19% of toddlers were fed takeaways or adult ready-meals for most meals. Early exposure to these types of meals, with high salt and fat content, can induce long-lasting preferences for these tastes (Venter & Harris, 2009) and limit the exposure to a variety of fruit and vegetables. The Scottish Government (2011a) advises parents to use home prepared foods (without salt or sugar added) rather than commercially made baby foods, as processed foods can prevent the learning and acceptability of individual food textures and tastes, whereas homemade foods enable the infant to grow accustomed to eating family foods.

2.6.3 Healthy diet beyond weaning

The key healthy diet messages for all age groups to address current dietary problems include increasing fruit and vegetable consumption, and decreasing intake of foods high in sugar and fat (Crombie et al, 2008).

2.6.3.1 Fruit and vegetable consumption

Fruit and vegetables are high in a good source of vitamins and minerals, as well as dietary fibre. The Department of Health (2000) and NHS (2009) recommend five portions of fruit and vegetables a day, to maximise health benefits from diet and lower the risk

of serious health problems associated with high salt and fat intake, such as diabetes, heart disease, stroke, obesity and some cancers.

The most recent sweep of the Growing Up in Scotland (GUS) longitudinal cohort study interviewed the parents of 3,471 children aged four to five years of age (Parkes & Wight, 2011). It was reported that 69% of these children lacked a varied fruit and vegetable diet (consuming less than five different portions the previous day), and 7% consuming none. The average daily number of different types of fruit and vegetables consumed was 3.5. It was found that children with less varied consumption of fruit and vegetables had poorer general, dental and mental health than children who consumed five of more portions of fruit and vegetables (Parkes & Wight, 2011).

It would appear that fruit and vegetable consumption decreases through childhood, with the Health Behaviour in School-aged Children (HBSC) international report from the 2005/2006 survey, showing that, amongst 11-year-olds in Scotland, only 55% of girls and 46% of boys ate fruit daily. Fruit consumption significantly decreases with increased deprivation, as well as age, with 34% of girls and 29% of boys at 15 years eating fruit daily (Currie et al, 2008). Similarly, the HBSC Scottish national report 2010 claimed that 36% of young people eat vegetables daily, with girls having higher rates than boys (Currie et al, 2011). There is no consistent trends in fruit and vegetable consumption between 2002 and 2010 (Currie et al, 2011), despite the Scottish diet being highlighted as a key priority in young people in recent government policy (Scottish Executive, 2003; Scottish Government, 2008a).

2.6.3.2 Reduction of sugary drinks, sweets, crisps and chips

As discussed in section 2.4.5, sugar-rich food and drinks are implicated as key contributors to the aetiology of both dental caries and obesity, and these types of foods and drinks, as well as foods high in fat, are consumed in high quantities throughout childhood.

The GUS study of 3,471 four to five year old children in Scotland found that 49% reported eating packets of sweets or chocolate bars at least once daily (10% reported more than once a day) and 41% reported consuming sugary drinks at least daily (29% reported more than once a day) (Parkes & Wight, 2011). This is comparable to the results of Scottish Health Survey 2008/9, which reported that of children aged two to 15 years of age, 53% ate sweets or chocolate and 37% consumed sugary drinks daily (Corbett et al, 2010). This demonstrates that dietary habits are established from early

childhood, as consumption of these sugary items is already prevalent from the age of four to five years.

The survey of sugar intake among children in Scotland 2006 found that the mean intake of NMES provided 17.4% of daily food energy in children aged three to 17years (McNeill et al, 2010), of which sucrose provided 13.4%. NMES as a percentage of food energy increased with age from 15.8% in three to seven year olds to 19.1% in 12-17 year olds. At all age groups, this is considerably higher than the recommended population average of no more than 11% food energy to be derived from NMES (Department of Health, 1991). The same value is recommended for saturated fat, which also was exceeded (mean intake in the survey was 13.8%). There was limited variation in NMES as a percentage of food energy due to socio-economic differences, yet there was an association with SIMD (mean intake was 18.4% in the most deprived quintile and 16.3% in the least deprived quintile; p=0.003) (Sheehy et al, 2008). The study concludes that it provides a sound baseline for future studies of NMES and fat intake of children in Scotland, which could be used for monitoring the impact of Scottish Government policy aimed at improving children's diet, and that to adhere to current dietary recommendations, there is clear need for major changes in NMES and saturated fat intake. Foods high in NMES are more likely to be eaten as a snack than as part of a meal. Macdiarmid et al (2009) investigated a sub-group of the sugar intake survey 2008 population, with 156 children aged five to 17 years completing a four-day non-weighed diet diary. The results showed that the median number of snacks per day was 2.0, with 'biscuits, cakes and pastries' being the most common snack food (eaten by 77% of children). Almost 40% of NMES intake was accounted for by snacking. This did not vary by sex, age, BMI and deprivation classification (SIMD).

Watt et al (2000) analysed data from the national diet and nutrition survey of 1,675 preschool children, and found that 56% consumed soft drinks more than once a day. These drinks have little or no nutritional value and can be high in NMES. Drinks contributed to 23% of total energy intake and 39% of NMES intake. Fifty-nine percent of the variance in the percentage of energy from NMES was due to consumption of soft drinks, fruit juice and whole and semi-skimmed milk. They concluded that advice on drinks consumption should be included in food guidelines for this age-group.

Dietary behaviour at six, 12 and 18 months of age, recorded by parents of 163 infants using a three-day diet diary, showed that the mean frequency of consumption of NMES-containing foods/drinks comprised 46, 60 and 67% of the mean total eating/drinking events at six, 12 and 18 months respectively (Habibian et al, 2002). Unfortunately, the

study does not detail the types of sugary food or drink which contribute to this alarming increase in sugar intake events with age, or the quantity of NMES consumed.

A positive finding by the HBSC 2010 report found that while 29% percent of 11-15 year old children in Scotland eat sweets daily (Currie at al, 2011), there has been a decrease of 16% since 2002. There was no difference in consumption between girls and boys. Sugary drinks, such as coke and other soft drinks, are consumed daily by more boys (25%) than girls (18%), and there is considerable increase in daily consumption between the ages 11 and 15 (11% to 26%). Diet soft drinks are consumed by 13% of young people, with no age or gender differences (Currie et al, 2011).

The GUS study of four to five year old children in Scotland, reported that 23% reported eating crisps at least once daily, with 15% having crisps more than once a day (Parkes & Wight, 2011). Twenty-one percent of 11-15 year old children eat crisps every day, whilst 8% eat chips every day. Daily consumption has halved for both crisps and chips since 2002 (Currie et al, 2011). However, the Scottish Health Survey 2008/2009 found that of children aged two to 15 years, 36% reported eating crisps daily (Corbett et al, 2010), showing either disparity in results or that the younger aged children are eating more crisps than the teenagers interviewed in the HBSC 2010 report.

2.7 Healthcare interventions: Diet improvement

2.7.1 Early Intervention in childhood

It is deemed necessary that there is a shift towards the development of a holistic programme aimed at improving overall nutritional status (Sheiham & Watt, 2000), with an integrated approach to the promotion of both oral and general health (Peterson, 2003). There is evidence that childhood nutrition impacts upon adult health status regardless of adult behaviour (Stamatakis et al, 2005). Childhood health behaviours may be easier to change than adult behaviours, especially when habits developed in childhood can track into adulthood, with potential consequences for health later in life. In recent years, efforts to facilitate change in dietary behaviour have been directed towards school children; however it is now hypothesised that interventions directed at promoting a healthy diet should be implemented in infancy, as there is evidence to suggest the first few post-natal months and the period of transition to the adult diet are a critical window of opportunity for programming long-term health (Anzman et al, 2010; Scottish Government, 2011a).

2.7.2 Government policy

The Early Years Framework signalled local and national government's joint commitment to break the cycle of passing on inequalities in health through generations, by prevention and early intervention, to give every child the best start in life (Scottish Government, 2008b). The Action Plan for Improving Oral Health and Modernising NHS Dental Services in Scotland recognises that healthy eating plays a central role in oral health, and the need for clear, consistent and achievable messages to improve public knowledge, with health professionals to continue working with nurseries, schools and communities to develop good dietary and oral health habits (Scottish Executive, 2005). A multi-disciplinary approach is advocated to improve both oral health and general health and well-being, with integration of health improvement programmes for better diet promotion (Scottish Executive, 2005).

2.7.3 Socio-economic differences in dietary behaviour in early childhood

National surveys have demonstrated the socio-economic disparities in the dietary behaviour of young children. The Growing Up in Scotland (GUS) study (Bradshaw et al, 2008) reported that material circumstances and other indicators of advantages and disadvantages are associated with healthy or less healthy eating. Socio-economic

position, maternal age, family situation and level of education are all important and interrelated. Younger mothers, mothers with less educational qualifications, lone parents and those with less household incomes were least likely to report their child ate two or more portions of fruits a day, and most likely to report that they ate sugary and savoury snacks and sugary soft drinks (Bradshaw et al 2008). The Southampton Women's survey also found that older mothers with a higher level of educational attainment were more likely to feed their infant a healthy diet (Robinson et al, 2007). Secondary analysis of the National Diet and Nutrition survey of children aged 1.5-4.5 years found that very few children met recommended intakes for vitamins and minerals, and energy from non-milk extrinsic sugars, and dietary adequacy was related to socio-economic position (Watt et al, 2001). The Avon Longitudinal Study of Parents and Children (ALSPAC) found that poor dietary habits were linked with low educational attainment (an indicator of low socio-economic status) of mothers. At 18 months, children whose mothers had low levels of education were less likely to eat cheese, fish, yoghurt, wholemeal bread, breakfast cereal, fruit and fruit juice, and more likely to eat chocolate, white bread, soft drinks, tea and chips (Rogers et al, 2003). The factors influencing dietary behaviour need to be better understood in order to direct dietary interventions, and particularly target disadvantaged children, to reduce this socio-economic inequality (Crombie et al, 2008).

2.7.3.1 Availability of healthy food

Crombie et al (2008) interviewed 300 mothers of two-year old children, living in deprived areas in Scotland and reported that access to shops was not considered a barrier to providing health foods, as all mothers did the majority of their shopping at a supermarket, and three-quarters could buy fruit and vegetables of good quality. One percent of mothers reported that availability of cooking facilities was a barrier to providing healthy meals, and 9% cited lack of storage space as a problem. The GUS longitudinal study of young children found that cost of food did not seem the most important influence on the feeding behaviours of mothers, but the relationship was more complex (Bradshaw et al, 2008).

2.7.3.2 Maternal attitudes and knowledge

It is thought that risk factors associated with dental caries and infant weight gain could be influenced by healthcare interventions aimed at improving feeding practices. Maternal attitudes to weaning are often inappropriate and misinformed, which can lead to unsuitable weaning diets. Parents' responses to infant temperament and their perception of infant growth and appetite could have roles in the development of

childhood obesity (Redsell et al, 2010), as well as establishing sub-optimal dietary patterns. It has been suggested that parents use a fussy infant temperament to determine when their child is hungry or when to begin weaning onto solid foods, as well as food being used as a soothing technique to calm a fussy infant (Wasser et al, 2011). Watt et al (2009) suggested that social support interventions that focus on feeding practices could play an important role in reducing inequalities in child health.

An online survey of 1000 mothers across the UK (Infant and Toddler Forum, 2009) with children aged between nine months and three years, asked about feeding habits and knowledge. Forty-three percent of mothers reported not receiving clear and consistent advice on feeding young children and 26% wanted more help from health professionals. Thirty four percent of mothers gleaned nutrition advice from the media, books and the internet, compared to 15% from their health visitor. Also, 31% of mothers questioned reported feeling tense, anxious and stressed during mealtimes. It has to be considered that the mothers completing the online survey may be a biased group having sought advice from infant feeding advice websites, perhaps due to their uncertainties and anxieties, and have been recruited through these websites to participate.

The survey of mothers of two-year-old children living in deprived areas reported that the level of general knowledge about food recommendations and the benefits of a healthy diet were very high (Crombie et al, 2008). Mothers were well informed about the links between diet and health outcomes, and almost all believed a healthy diet was good for their child, both in the short and long term. All the mothers interviewed knew that experts recommend more vegetables, salad, fruit, and less fried foods, crisps and confectionery. All mothers knew that less sugar will help maintain a healthy weight, and a healthy diet would be better for their child's teeth and heart. However, lower awareness of specific dietary recommendations was significantly associated with poorer diet, and many mothers felt confused about recommendations (Crombie et al, 2008). Forty-five percent of mothers almost never offered previously rejected food to their child, 47% said they were unlikely to provide two to three portions of fruit (or of vegetables) daily, and 41% said they were unlikely to limit sweets every day (Crombie et al, 2008).

The GUS study found in many cases, mothers' knowledge of cooking was cited as a barrier in feeding patterns (Bradshaw et al, 2008). Crombie et al (2008) reported that most mothers interviewed reported knowing how to make meals such as soup, mince and potatoes and spaghetti bolognaise, however less than half reported that they could make curry, fruit salad or pizza. Improved knowledge and confidence of cooking may improve eating patterns (Bradshaw et al, 2008).

2.7.3.3 Lifestyle

Results from the Southampton Women's survey (Robinson et al, 2007) found that the key determinant of the nature of an infant's diet is the quality of the mother's diet, observed at six months and more marked at 12 months of age when diet is more strongly based on family foods ($p<0.001$). Family environment impacts on unhealthy eating behaviours, observed by the impact on children's weight (Campbell et al, 2008), and maternal uncertainty of infant behaviour can lead parents to overfeed (Redsell et al, 2010). Crombie et al (2008) found that 35% of interviewed mothers, living in deprived areas, agreed with the statement that 'providing a healthy diet is difficult because I have a busy lifestyle' and 32% reported that their household never ate a main meal together in the last week. Despite 82% of mothers reporting they could make soup, only 7% did so, suggesting influences, such as attitudes and lifestyle affect feeding patterns (Crombie et al, 2008).

2.7.4 Evidence base for health education methods

Evidence-based healthcare asks for the questioning of the effectiveness of current health education methods and the implementation of proven health strategies (Sheiham & Watt, 2000). National surveys show that infant feeding practices in the UK are highly variable. There are very few studies that have evaluated healthcare interventions focussed on infant feeding beyond breastfeeding (Watt et al, 2009). Some results have been disappointing, as interventions delivered by health professionals have shown limited effect on later infant feeding practices, especially amongst socially disadvantaged women (Watt et al, 2009). In a study by Savage et al (1998) only 28 of 98 mothers reported the health visitor or doctor as the greatest influence on when to wean their baby, and the dominant perception was that weaning was necessary to satisfy the infant. Further research into parental attitudes and beliefs could help untangle the underlying causes of non-compliance with weaning recommendations.

It has been suggested that weaning practice can be influenced by social circumstances. Weaning practice may be sensitive to education, social class and the input of health professionals, which implies there is scope for improvement, especially if educational messages can be focussed on the appropriate groups: families of lower social class and educational attainment (Savage et al, 1998). There is a need to influence a proper balanced nutrition, especially in areas of social deprivation.

2.7.4.1 Dietary behaviour interventions

Systematic reviews of individual diet interventions to reduce dietary risk factors found positive changes in fruit and vegetable intake and decreases in fat intake (Ammerman et al, 2000), improvements in BMI status and weight loss in children (Summerbell et al, 2005; Collins et al, 2007), and reduction in cholesterol and fat intake, blood pressure and cardiovascular risk status (Brunner et al, 1997). The systematic review by Ammerman et al (2000) to examine efficacy of interventions to modify dietary behaviour related to cancer risk found that studies of interventions that involved social support, family involvement, goal-setting and interactive activities involving food were deemed more likely to show a favourable increase in fruit and vegetable intake and a reduction of dietary fat. However, there is little data on the efficacy of interventions by subgroup, particularly low-income or ethnic subgroups, and cost-effectiveness (Ammerman et al, 2000; Summerbell et al, 2005). Maintenance of behavioural changes following interventions is often not investigated or reported (Collins et al, 2007), but is found to be associated with a greater length of intervention (> 24 weeks), face-to-face contact, use of more intervention strategies and follow-up prompts (Fjeldsoe et al, 2011). Ammerman et al (2000) reported that few studies followed participants for more than a year and often showed a falling off from the initial change in dietary behaviour. The authors called for future interventions studies to assess dietary intake at the individual level and collect data aimed to identify determinants of behaviour change, with information to compare cost-effectiveness of different intervention approaches. Also there needs to be more research into the efficacy of interventions in high-risk, hard-to reach populations, and the evaluation of long-term maintenance of the change (Ammerman et al, 2000; Collins et al, 2007).

2.8 Health Improvement: Caries Prevention

2.8.1 The need for prevention

It is reported the dental caries is one of the most costly diet-related chronic diseases, and those with childhood caries are more likely to have affected adult teeth, consuming even more treatment resources throughout life (Arora, Scott et al, 2011). Treatment of dental caries is a huge financial burden to the healthcare budget. Prevention of the disease, particularly from a young age, may prove to be a cost-effective approach. An Action Plan for Improving Oral Health and Modernising NHS Dental Services in Scotland (Scottish Executive, 2005) sets out a range of oral health improvement measures, particularly for children, to prevent dental disease and improve access to dental services. The action plan recognises that the basis for good oral dental health begins early in life.

2.8.2 Early dental healthcare intervention

In terms of dental health, long-term damage may already have occurred before reaching school age. As dental caries tends to follow a chronic disease pattern in susceptible populations, it is necessary to maximise dental health gains in the youngest possible age groups if the incidence of caries is to be minimised (Blair et al, 2006) into adulthood. It now seems appropriate that programmes of dental health promotion for mothers should be initiated before eruption of primary teeth. Gussy et al (2006) state that the window of opportunity for the maximum impact on oral health may be in the first six to 12 months of life, with primary healthcare providers other than dental professionals most suitably placed to provide health promotion and early intervention. There is evidence of caries prevention counselling to parents of young children having a positive effect. Kowash et al (2000) found that repeated home visits to mothers with young infants, commencing at or soon after the time of the eruption of the first deciduous teeth, was effective in preventing the occurrence of dental caries, improving oral hygiene and dental attendance.

Watt and McGlone (2003) reviewed the literature for oral health education and promotion interventions and concluded that there was a limited number of high quality studies aimed at altering diet to promote oral health, and very few undertaken within primary dental care settings. Research in Brazil showed that home visits offering dietary advice appeared to help reduce dental caries in infants, but the cost-effectiveness and long term impacts of the intervention are unknown (Feldens et al, 2007). A large scale study (over 1000 children aged between two and five years were examined) in the USA

found that, following a paediatrician training intervention, parental counselling on reducing early childhood caries risk was associated with a 77% lower incidence of childhood caries over time than at comparison sites where no training was offered (Kressin et al, 2009). The authors recommended further studies to validate this potentially significant public health impact on reducing dental caries in young children.

2.8.3 Aims of dental services

The aim of NHS oral health initiatives undertaken by both the Scottish government and local health boards in recent years has been to increase the prevalence of good oral health from an early age by encouraging:

- daily regular brushing with fluoride toothpaste
- application of fluoride varnish to the teeth
- improvement of children's diet by reducing sugars
- registration with a dentist.

These are the key activities undertaken within the Scottish Childsmile framework (www.child-smile.org). The Childsmile programme began in 2006, with the aim of being integrated into mainstream dental services by the end of 2011 (Turner et al, 2010).

2.8.4 Remuneration for Childsmile activity

The integration of Childsmile Practice activity into the Statement of Dental Remuneration (SDR) for NHS general dental activity will take place in October 2011. This will see an additional capitation payment for undertaking key preventive actions (as well as fee per item for fluoride varnish application) (Scottish Government, 2011b). The capitation payment reflects the additional work required by NHS dental practitioners and practice team members (such as Childsmile-trained extended-duty dental nurses (EDDNs)), to provide preventive interventions for each enrolled child. To support practices to deliver an intensive programme of care for families requiring additional support (anticipated to be the majority of children residing in the most deprived quintiles SIMD Q1-Q3), an additional support payment will be made (Childsmile, 2010).

2.8.5 Delivery of Childsmile Practice

Currently, oral health promotion is delivered by EDDNs, in addition to dentists, in the dental practice, to families of young children (three months to six years of age) participating in Childsmile. In some cases, where dental attendance is poor, dental health support workers (DHSWs) provide oral health promotion during scheduled home visits, and aim to facilitate registration with a dental practice. Preventive interventions expected, in order to receive the capitation payment include the giving of dietary advice, toothbrushing demonstration/fluoride advice, and clinical prevention as required (Childsmile, 2010).

Using the Programme Manual (Childsmile, 2011a), dental health and nutrition advice is given via discussion, and comprises of the topics: tooth decay, why first teeth are important, nutrition and weaning, sugar-free medicines, teething, and tooth brushing instruction with demonstration. Specifically, dietary advice consists of encouraging an exclusively milk diet until around the age of six months, and recommending foods to introduce when weaning begins and progresses to a solid food diet. Key points are informing parents that it is how often and the length of time that sugar is in the mouth that is important in terms of dental health, and the discouragement of sweetened drinks, especially if left with the baby overnight or between meals. These messages are reiterated at each Childsmile visit, which occur at three to six month intervals. Current Childsmile recommendations for dietary interventions for children from one year of age, requiring enhanced prevention (those assessed as having increased caries risk), includes considering the use of diet diaries alongside action planning, and positive and supportive motivation (Childsmile, 2011b). These recommendations echo the clinical guidance on the prevention and management of dental caries in children from the Scottish Dental Clinical Effectiveness Programme (SDCEP) (2010). The guidance recommends giving dietary advice for oral health, and also general health, at least once a year as standard prevention for all children and at each recall visit as enhanced prevention for children at increased risk of caries. Additionally, for children over one year of age, requiring enhanced prevention, the guidance recommends the dental team consider the use of a food and drink diary, to be completed by the child or their parent/carer over a three-day period. The diary should then be reviewed by a member of the dental team and advice offered if necessary (SDCEP, 2010).

All NHS dental practices are expected to sign this Childsmile service level agreement, and therefore, dietary advice, alongside other preventive interventions, is to be provided for all young children registered. Currently however, there is no central

monitoring of diet recording or measurement of sugar intake to determine the individual risks of each child and the need for targeted prevention advice.

A suitable dietary assessment tool could aid the achievement of the dietary behaviour aims of Childsmile Practice in two ways. Firstly, as a dietary assessment tool within the programme framework: the use of a tool to record an individual child's diet by their parent/carer allows face-to-face discussion with a healthcare professional (such as their dentist, Childsmile-trained EDDN or DHSW) and provision of individually tailored advice to promote healthy dietary behaviour. Secondly, the tool could be used within research strategies of the Childsmile evaluation programme to monitor and compare the effectiveness of different dietary interventions, with a view to improving the quality of the intervention overall.

2.8.6 Recommended steps in dietary counselling

Evidence-based guidelines for effective dietary advice (Roe et al, 1997; Watt et al, 2003) recommend that interventions should be designed from behavioural theory and suggest this six step model for a systematic approach:

- Identify higher risk patients requiring a higher level of support
- Take a detailed dietary history to ascertain all relevant background information, most often used in a dental setting is a three-day diet diary
- Set well-defined goals, which are realistic, appropriate (tailored to an individual's personal circumstances) and measurable, and agreed upon by the patient
- Develop an action plan, and encourage support from family and friends to aid motivation and maintenance of change
- Monitor and review, giving feedback and on-going support, with repeated contact over a period of time to promote sustained changes in dietary habits
- Know to refer individuals with complex medical conditions, special diets or extreme dietary patterns for more expert guidance

Watt et al (2003) comment that in primary dental care settings, the aim of the dietary assessment is not to calculate precise nutrient intakes, but collect information most

relevant to dental health: number of intakes per day (how many of these were snacks, how many contained NMES, and the timing of intakes during the day, particularly before bedtime). While a diet diary may not be required for all patients, Watt et al (2003) suggest its use in patients with a high caries experience or considered to have a high caries risk (including some pre-school children and lower socio-economic groups).

This systematic approach requires assessment tools that have a professional format and a team approach to best utilise resources. Appropriately trained dental nurses are suggested as an alternative to a dentist to conduct a detailed dietary assessment, create an action plan, and monitor and review diet behaviour (Watt et al, 2003).

2.8.7 Childsmile in Dumfries and Galloway

The Childsmile programme in Dumfries and Galloway was established in 2010, with the first interventions beginning in August 2010. During the timeline of this project, the study population in this area was unaffected by the developments in the Childsmile implementation. Therefore, it was considered as a baseline of the expected dietary behaviours prior to the intervention of dietary advice given by DHSWs and EDDNs.

2.9 Dietary Assessment

Accurate methods of recording nutrient intake are vital in examining the association between diet and health (Boushey et al 2009). In order to examine the effectiveness of public health measures to improve nutrition, a method of collecting information about dietary behaviour, and changes in dietary behaviour, needs to be considered and validated.

2.9.1 Analysing dietary behaviour

Current practice by dentists, in the recording of a patient's diet to examine risk factors for dental caries and erosion, and the provision of individually-tailored dietary advice, is not standardised. Moyhihan (2002) reports that dietary advice is not given by many dentists, and when it is, is often ad hoc, as a single statement, with little patient interaction and follow-up. This may be due to time, space, frequency of dental visits and financial constraints, in terms of salary remuneration. However, to illicit dietary change through promotion and intervention, advice needs to be clear, consistent and personal to each patient (Moyhihan, 2002).

Particularly with regard to the Childsmile oral health improvement programme, emphasis on recording aspects of feeding behaviours relevant to the pathogenesis of dental caries needs to be examined in very young children, from the age of weaning. Once a model has been developed in order to correctly analyse dietary behaviour, then examination of the effect of the healthcare intervention can assess outcomes such as:

- Reduction in sugar intake/ frequency of sugar episodes
- Impact of intervention on oral health/ general health
- Effectiveness of this type of nutritional intervention

2.9.2 Dietary assessment tools

The development of a dietary assessment tool for pre-school age children will be useful to aid the development and evaluation of Childsmile as well as other projects requiring a measure of dietary sugar intake/episodes for this age group to be considered within their models.

Few dietary assessment tools have been developed for young children (less than one year-olds), as although several measurement techniques exist, a number of factors restrict their suitability for large-scale studies with children. Rapidly changing dietary behaviour during the weaning period, introduction of new foods and changes in portion size, make dietary assessment in early childhood particularly difficult to measure accurately. Assessment of energy intake is challenging even under the most controlled research conditions. There are a number of different methodologies used to collect dietary data and typically assessment includes a combination of methods (24-hour recalls, food records and food frequency questionnaires).

2.9.2.1 Twenty-four hour recall

A 24-hour dietary recall of current feeding habits can offer a good assessment of children's dietary intake, but the amount of time and resources required to gather data limit their usefulness for large-scale evaluations. It requires a one-to-one interview, with the interviewer asking the participant to recall all the food and drink consumed over the last 24 hours, possibly with the use of visual aids to help estimate portion size. A 24-hour recall has ease of application, and is considered one of the less burdensome diet recording methods (Holmes et al, 2007) but has limitations, especially those associated with recall bias. Ideally 24-hour recalls are repeated several times, to obtain a view of the individual's usual dietary intake (Nelson et al, 2008), with Pereira et al (2010) reporting the need of between 14 and 23 replications of the 24-hour multiple-pass recall method for accurate estimation of energy intake.

2.9.2.2 Food Frequency Questionnaires

Food Frequency Questionnaires (FFQs) ask participants how often they consume specific foods and beverages and the sizes of their usual portions, estimating intake over several months. They are commonly used to assess diet in large scale evaluations with adult populations, but may not be suitable for use with young children, as a child's estimate of portion sizes and frequency are limited by their cognitive abilities. For children too young to complete themselves, the FFQ could be completed third party, but is only a true representation of eating habits when parent and child are together, relying on the parent/carer knowing the usual pattern of eating for the child (Palmer et al, 2010). Also, for young children, dietary changes (food types and portion sizes) can vary rapidly over a few months. For these reasons, it is generally accepted that FFQs are not suitable for children under the age of three years.

A FFQ was the method of dietary behaviour recording used in the previously mentioned survey of sugar intake among children (three to 17-year olds) in Scotland (Sheehy et al, 2008). Therefore the results may be limited in drawing conclusions regarding effect of frequency of sugar intake, as the questions did not capture information about the number of sugar episodes per day, compared to an estimated long-term intake.

2.9.2.3 Diet diaries

The main limitation of retrospective recall (used in 24-hour recall and FFQs) is the reliance on memory which can allow recall bias and inaccuracies to affect the validity of information. An alternative method employed to overcome this is the diet diary. By capturing information during/close to the event and limiting recall, it is believed that diaries can produce more accurate and less biased data (Stone et al, 2003). Diet diaries rely on participant compliance, as for several days, the participant (or for small children, the carer) records the foods, drinks, amounts and preparation methods for everything they consume. This may include weighed food intake. Portion sizes are important to assess nutritional intake (Harris, 2008). Diaries involve a high level of participant burden, and are prone to under reporting and alterations in diet. They are reliant on participants complying with diary protocol and completing the diary in a timely manner, as there is the risk of faking or backfilling written entries in order to appear to have good compliance (Stone et al, 2003). They can be accurate when completed by a third party such as parents, but as with food frequency questionnaires, the information recorded is only true for time periods when the parent and child are together, such as at home and not school, which is problematic (Cameron et al, 2006). This obstacle can be overcome more easily than with FFQs, as the diet diary can be passed between carers, but places more burden on respondents. Diet diaries do not allow for variations in an individual's behaviour and can be limited in their ability to capture usual intake compared to a FFQ (Marshall et al, 2003). However, they do allow more detailed information about timing and quantity of food intake during the diary period, rather than the generalised, non-specific dietary behaviour recorded in a questionnaire.

2.9.2.4 Applications of diet diaries

Diet diaries aimed at collecting data for very young age-groups have been successfully used in previous, highly regarded studies (for example, the Cambridge Baby Growth Study (MRC Epidemiology Unit, 2011) and within the ALSPAC study (Cowin et al, 2000). The current National Diet and Nutrition Survey (Bates et al, 2010) has chosen the diet diary method for collecting information on infant feeding. The demographic profile of

participants within the Cambridge and Avon studies is thought to vary considerably from the demography of Scottish Childsmile participants and it is important to establish whether this methodology of dietary behaviour collection is appropriate to be used within the context of the Childsmile evaluation programme.

2.10 Conclusions

Thirty-six percent of five-year old children in Scotland have visible decay (Macpherson, Conway et al, 2010), despite being largely preventable by fluoride exposure, good oral hygiene and a low sugar, non-cariogenic diet. Nationally, the Childsmile programme has enabled preventive interventions of fluoride applications and toothbrushing with fluoride-containing toothpaste at nurseries and schools (Turner et al, 2010), and whilst there is provision within the programme for targeted dietary advice, this is the area which is most difficult to regulate and evaluate the improvement. Literature suggests that early intervention before dietary behaviour is established is important in making a substantial effect in the habits that could lead to unhealthy choices, leaving children susceptible to dental caries as well as other health problems caused by poor diet.

This study aims to investigate a method of recording dietary behaviour in weaning infants and young children up to 18 months of age, and its practicality in evaluating adherence to dietary recommendations appropriate for this age group. Differences in social and family circumstances will be explored to assess variations in dietary behaviour.

3 Chapter 3 – Research Aims and Objectives

3.1 Aims

The research study has two main aims: firstly to design, develop and evaluate a dietary assessment tool for use in a large ongoing oral health improvement programme for Scottish children of weaning and toddler age (Childsmile) and secondly, to investigate how social and family circumstances impact on the practical utility of this tool.

3.2 Hypotheses

Detailed dietary behaviour of weaning babies and young children from six months up to 18 months of age can be collected by parents/carers by the use of the dietary assessment tool.

There is a social gradient in the acceptance, compliance, completeness and quality of the information collected by the dietary assessment tool.

3.3 Objectives

- Firstly to examine how the social and family circumstances of participants vary with non-participants and within subgroups of the participants.
- To investigate the practicality of using a dietary assessment tool for this young age group, and if this varies with social and family circumstances.
- Dependent on the success of the use of the tool by participants and the quality of data obtained, to establish if useful nutrient data can be extracted to enable detailed dietary assessment, and examination of the dietary behaviour of the study group.

3.3.1 Research questions

1. What is the socio-demographic profile of participants? Is SIMD an appropriate measure of deprivation for this study?

2. What is the practical utility of the dietary assessment tool, and is it influenced by socio-economic and family circumstances?

This is to be judged in terms of:

a) the recruitment rate of participants into the study (Quantitative)

b) the practicalities of diary administration (time implications of involvement in the study for participants, and for the researcher; cost implications to administer the tool, parental support, analysis of the data (Quantitative))

c) the compliance rate amongst parents/carers of young children (Quantitative)

d) the completeness of the dietary assessment tool (Quantitative). Who is completing the dietary assessment tool? Are parents/ childminders/ nurseries/ grandparents involved? Do they need different levels of support? (Qualitative)

e) how acceptable is this tool and dietary behaviour data collection to parents/carers? (Qualitative)

f) what are the current weaning and feeding practices of participants (information derived from an introductory diet questionnaire), and how does this study population compare with recommended standards? (Quantitative)

g) the quality of the data obtained by the dietary assessment tool (Quantitative). Is the dietary information provided by the tool detailed enough to allow nutritionally valuable and useful information on the weaning diet of participants to be analysed? If so, how does this study population compare to the recommended standards, and other diet and nutrition surveys?

Chapter 4 - Methods

4.1 Ethical Approval

4.1.1 Research Ethics Committee Application

The NHS Research Ethics Committee (REC) application was completed online, using the Integrated Research Application System (IRAS), and sent to the West of Scotland REC (REC4), along with the study protocol, patient information leaflets, consent forms and questionnaires to be used in the data collection. Following the meeting of the committee in Glasgow, amendments were made to the recruitment process. Ethical approval for the project was granted in January 2010 (application reference number: 09/S0704/82). After participant engagement, a substantial amendment was applied for in order to examine the socio-demographic characteristics of the participants compared to the eligible study population (those invited to participate). The committee gave favourable ethical opinion of the amendment with approval granted in October 2010 (reference number: 09/S0704/82).

4.1.2 Research and Development approval

Local NHS board approval was required, and the Research and Development form completed on the IRAS website was sent to the local Dumfries and Galloway NHS Research and Development Group. The site specific form outlined the process of recruitment and data collection in Dumfries.

4.1.3 Sponsorship

The REC requires a Research Governance Sponsor for each study. This was provided by Dr G. Baxter of the Dumfries and Galloway Research and Development Support Unit.

4.2 Funding

Researcher expenses were covered by NHS Education for Scotland, and printing costs covered by Childsmile evaluation programme funding. There were very little other costs to the project.

4.3 Development of the diet diary

A three day unweighed diet diary was developed for use by parents/carers of children aged six to 18 months. The diary was adapted (in collaboration with a senior lecturer in public health nutrition) from comparable diaries used in established studies[2]:

- Cambridge Baby Growth Study (MRC Epidemiology Unit, 2011)
- The Avon Longitudinal Study of Parents and Children (Cowin et al, 2000)
- The National Diet and Nutrition Survey 2009 (Bates et al, 2010)

A diet diary was deemed the most suitable dietary assessment tool for the weaning age group. A food frequency questionnaire would be greatly affected by the introduction of new foods, as would a 24-hour recall by the rapid changes in quantity and type of foods and drinks. Also, a food frequency questionnaire would not capture important information for this dental health focussed study, about the frequency of sugar episodes per day, rather than over a longer time period. The disadvantages of diet diaries are diminished with young age groups, because the children are under close supervision and fed by parents and carers, so accurate recording is achievable. The above established studies use the diet diary method to assess the diet of weaning babies and young children, and for these reasons, it was chosen for this study.

The format and content of the diary was developed with the assistance of a senior lecturer in public health nutrition, with a design enabling recording of the date and time of each entry, types and amounts of drinks, including formula milk and breastmilk, type of food (including ingredients of homemade meals and brand names of processed foods), amount offered to and left by the child, and the time taken to consume the meal/drink. It also allowed recording of who filled in the diary on each day. The diary was piloted by a number of mothers, informally, to gauge opinion of ease of completion and amount of written instruction required. After further alterations, the final edition of the diary (Appendix 1) was formatted to an appropriate standard using professional printing services at the University of Glasgow.

[2] The format of these diaries can be viewed on the Medical Research Council website: Diet and physical activity measurement toolkit.

4.4 Study Population

The study population was parents/carers of young children aged between 6 and 18 months registered at two medical practices in Dumfries and the local area. All eligible parents/carers (N= 83) were invited by their health visitor to participate in the study.

4.4.1 Selection criteria

A) To have a child that can be categorised into one of these three groups:

Aged 6 months +/- 2 weeks (SIMD 1-5)

Aged 12 months +/- 2 weeks (SIMD 1-5)

Aged 18 months +/- 2 weeks. (SIMD 1-5)

B) Ability to read and write English without assistance

4.4.2 Exclusion Criteria

A) Pre-term babies

B) Babies with illness affecting their normal dietary behaviour

4.5 Recruitment

Contact details of eligible parents/carers were obtained from their health visitor's case files. Invitation letters and study information sheets (Appendices 2 and 3) were sent from their health visitor to parents/carers at the time when their child was due to reach the age groups as shown in the selection criteria. Eighty-three letters were sent over a six-month period. The letter had the contact details of the researcher (MW), and invited the parents/carers to contact her if interested in taking part. Eight participants contacted the researcher by phone call, text or email, requesting to take part in the study. The letter also stated that, if no response, a health visitor would contact them by telephone, approximately 10 days after receiving the letter. The telephone call from the health visitor supporting this study invited the parent/carer of the child into the study. Attempts were made to contact 75 parents/carers by phone call. Figure 4-1 illustrates the pathway for recruitment and participation in the study.

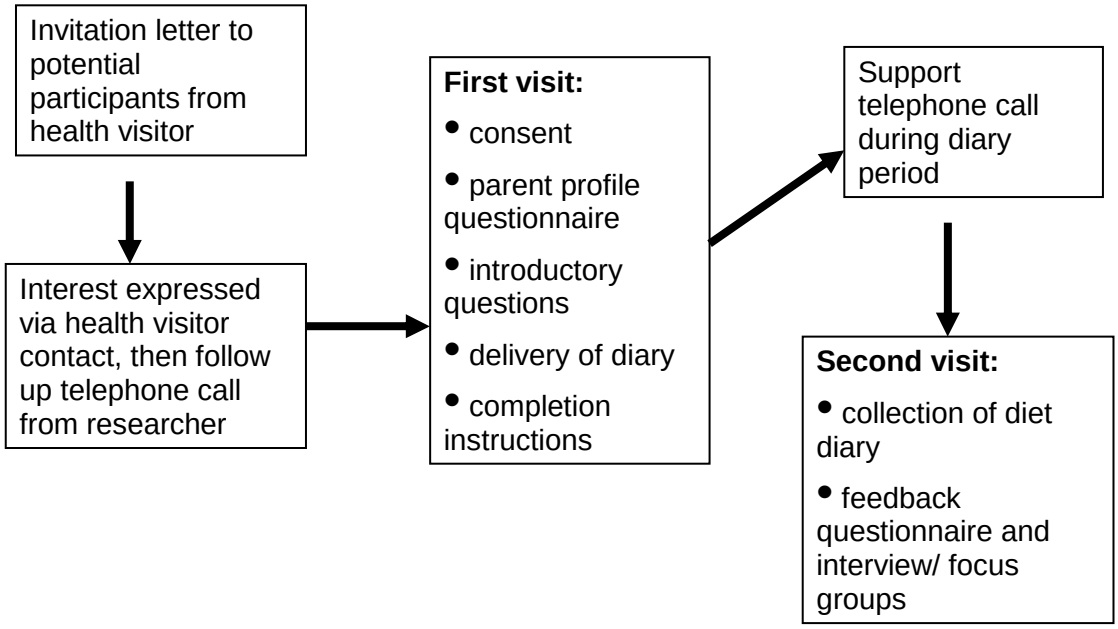

Figure 4-1 Flow diagram showing the process of recruitment and participation in the study

4.6 Consent

By telephone, the health visitor gained verbal consent of 34 participants to be contacted by the researcher. The eight participants who contacted the researcher independently gave consent in their voluntary contact. Then the researcher, on first telephone contact, gained verbal consent from 37 participants to visit their homes or other convenient location to engage them in the study. Five parents/carers failed to join the study at the point of researcher contact, either because it was not possible to contact them, or they refused to take part in the study.

4.7 Participant engagement

Throughout the study period, a log diary of research activities was kept by the researcher in order to calculate the practicalities of diary administration, in terms of cost of resources, transport and time spent visiting participants and analysing data.

4.7.1 First visit

On first visit to the participants' homes, the researcher gained written consent from the parent to take part in the study using the consent form (Appendix 4) approved by the REC. They were all asked if they had read over the information sheet sent out with the recruitment letter. Two copies of the consent form were signed by the participant (parent/carer of the subject child) and the researcher. In each case, one consent form was retained by the researcher and the other was kept by the participant.

4.7.2 Structured interview

Information was gathered from the participant during a structured one-to-one interview using the REC-approved Parent Profile Questionnaire (Appendix 5) and the Introductory Diet Information Form (Appendix 6).

4.7.3 Instructions on diary use

Verbal instructions were given by the researcher to the participant, and other present family members involved in the feeding of the child. This involved the talking through of the diary, demonstrating the quantities (using props brought by the researcher) and detail of information required, and advice on completion. Any questions from the participants were answered in order to aid their completion of the diary. Participants were given the researcher's phone number, if they required any support during the diary completion period.

4.7.4 Collection of the diary

A mutually convenient date was arranged for the researcher to collect the completed diary from the participant's home/workplace, and at this point the diary was briefly checked over by the researcher, for completeness and to clarify any uncertainties in the diary (such as brand of food item). An informal discussion about the diary and their experience was held, with semi-structured questions asked in order to gain feedback on the process from the participants. General themes discussed followed these questions:

- How did you find the diary and the process of filling it in?
- How did you find the length of the diary period?
- Were the diary days typical?
- Was the diary any help to the parents/carers?
- Did you find anything helped with completion of the diary?
- How do they feel about a paper diary compared to a computer/phone diary?

The participants' comments were recorded during each interview. At this visit, the researcher asked the participant if they wished to be invited to focus groups at the end

of the data collection period, and gained their verbal consent to be contacted by telephone by the researcher in the future.

4.8 Focus groups

When coming to an end of the recruitment, it was arranged to have four focus groups held at different localities around Dumfries for ease of attendance of participants. Two were to be held on one day in a seminar room at the Education centre of the Dumfries and Galloway Royal Infirmary, and a second day was organised with one group to be held at New Abbey Village Hall, and the second session at the Lochside Education Centre. Using the information gathered informally when collecting the diaries from participants, and incorporating key themes from the research questions, a structured schedule was developed to follow during the focus groups (Appendix 7). Support was provided at the first day by a regional Childsmile researcher.

Written consent was gained by the attendees (Appendix 8) for the recording of the sessions. These recordings were transcribed by the chief researcher (MW), following recommended guidelines (Murphy et al, 1992; Barbour & Members of WoReN, 2000).

4.9 Analysis of collected data

4.9.1 Parent profile information

Analysis of the parent profile questionnaire was performed by the chief researcher. The parent profile questionnaire gathered information about socio-economic status (including area-based measures obtained from participant's postcode and individual measures, such as education, employment and income) and demographic questions about family situation (age of mother, number and age of other children, and health visitor support).

4.9.1.1 Scottish Index of multiple deprivation

As discussed in section 2.3.3, SIMD, an area-based measure of deprivation, is calculated from individual domains of income, employment, education, housing, health, crime and geographical access and presented at data zone level. The full index of data zones are separated into quintiles, which are percentiles divided into fifths (20^{th}, 40^{th}, 60^{th} and 80^{th} percentiles). SIMD Q1 is the most deprived 20% and SIMD Q5 is the least deprived 20%. Assignment of SIMD quintile value was given by entering the participants' postcodes into the national SIMD data bank (Scottish Government, 2010a). The database for Dumfries and Galloway SIMD 2009 was used (Scottish Government, 2010b).

4.9.1.2 Parental occupation

The occupation of the parent(s) in the household of the subject child was classified using the Standard Occupation Classification 2010 (Office for National Statistics, 2010a), as shown in table 4-1 below. Mothers that considered themselves as housewives, were classified as a code 6, as recommended by the classification system.

CODE	Occupation Grouping
1	Managers and Senior Officials
2	Professionals
3	Associate Professional/Technical
4	Admin and Secretarial
5	Skilled trades
6	Caring, leisure and services
7	Sales and customer services
8	Process, plant machinery
9	Elementary occupations
U	Unemployed

Table 4-1 Occupation Codes (SOC 2010)

For analytic purposes and due to the small study population size, the SOC classes were collapsed into three groups to match the National Statistics socio-economic classification (NS-SEC), according to the recommendations by the Office for National Statistics (2010b). NS-SEC is an occupationally-based classification with rules to provide coverage for the whole adult population. Assigning an NS-SEC category to a household involves deciding which household member best defines that household's position, and in the case of joint householders, the person with the highest income takes precedence. Each household involved in the study was considered and assigned to one of the following NS-SEC groups:

NS-SEC 1: Higher managerial, administrative and professional occupations (SOC codes 1 and 2)

NS-SEC 2: Intermediate occupations (SOC codes 3 and 4)

NS-SEC 3: Routine and manual occupations (SOC codes 5, 6 and 7)

* those who have never worked or have been long-term unemployed

4.9.1.3 Parental education

Two questions were asked to the participant about their education: the number of years of full-time education they completed, and the highest level of education they achieved (primary school; secondary school; sixth form college; college of further education; university; postgraduate studies).

4.9.1.4 Household Income

The participant was asked to choose from a table (Appendix 5) the gross annual household income bracket that best reflects their personal household. This method had previously been used in a similar study within the Childsmile evaluation group and in the survey of sugar intake among children in Scotland (Sheehy et al, 2008). Then the participant had to choose what proportion of this income was derived from government benefits, from several options (Appendix 5). These results were collapsed into smaller groups according to distribution of the participants.

4.9.2 Practicalities of diary administration

The log diary of research activities was analysed to calculate the cost of resources, transport costs and time spent travelling to and interviewing participants at their homes. Also the time spent analysing the data was calculated to estimate the practicality of use of the diary within the Childsmile programme.

4.9.3 Qualitative analysis

4.9.3.1 Feedback interview

The notes made during the semi-structured feedback interview were drawn together to combine opinions into broad discussion points, based on the participants' opinions of:

- the diary and the completion process
- the length of the diary period
- how accurate and typical was the diet recorded in the diaries
- if the diary was of any benefit to the participant
- if the participants found anything helped with completion of the diary

- how they would feel about a computer/phone diary

Coding of the participants' comments and the aggregation of data was conducted by the primary researcher, following established methodology (Murphy et al, 1992; Malterud, 1993; Barbour & Members of WoReN, 2000). Appropriate responses were collated under category headings, including contradictory points of view and new insights. The most useful quotes were selected to substantiate various ideas and points of view. A summary outlining the most important ideas was prepared, weaving brief quotes into the text.

4.9.3.2 Focus groups

Transcripts from the focus groups were coded into overarching themes, similar to the topics discussed during the feedback interviews. Additional discussion points involved participation within health studies. Again, established methodology was followed (Murphy et al, 1992; Malterud, 1993; Barbour & Members of WoReN, 2000). The themes were identified by initial overview of the material, with refinement of coding, and then elements of the text covered by the codes were identified and grouped, with their common meaning expressed as concepts. This is displayed as quotes relevant to the individual participant feedback discussion points. Together, with those comments, the qualitative analysis articulates the meaning of all the similarly coded elements as concepts of participants' attitudes towards the acceptability of the diet diary and dietary assessment.

4.9.4 Introductory Diet Information

The introductory diet information form gathered information about weaning of the child up to the time of the diary completion (Appendix 6). Questions were asked about breastfeeding initiation and duration, age of introducing solid foods, types of foods and drinks introduced and at what age. Also, information about the type of drinking vessel used by each child at this age was collected, as well as questions about teeth present, toothbrushing habits and medicines.

The responses from participants were compared to current recommendations from clinical guidelines from national government-funded health agencies: Department of Health; National Institute for Health and clinical Excellence (NICE); NHS Health Scotland; Scottish Dental Effectiveness Programme (SDCEP). Recommendations from the WHO, and guidance from the Infant and Toddler Forum, an independent health advisory committee, are also referenced. Additionally, the Childsmile care manual (Childsmile, 2007) was included, which since the time of the study, has now been modified to no

longer include specific diet recommendations, but at the time of the study was available to dental professionals for reference.

4.9.5 Diet diary analysis

4.9.5.1 Quality of the diaries

On return of the diaries, analysis of each was performed by the primary researcher. The amount and detail of information provided was considered, compared to the ideal, which was described to the participants when instructing them on completion. Each diary was ranked from 1 to 5, in the level of completeness. Completeness was judged by the level of detail of the following:

- Time/duration of eating/drinking completed? Yes/no
- Types of food/drinks completed? Yes/no (including brand names, flavours, ingredients of home cooked foods)
- Amounts of food/drinks completed? Yes/no (quantities offered and left)
- Dating of each day, and who was looking after the child completed? Yes/no
- Inclusion of any medicines/ vitamins?

Also, the diaries were examined for any gaps in the entries with missing information. This ranking was conducted by the chief researcher, but also independently assessed by another examiner, who had no information about the participants. The two assessments were compared to give a final ranking of completeness.

Additionally the number of days taken to complete the diary, and number of carers involved in completing the diary were recorded and examined.

4.9.5.2 Dietary data extraction

The diaries were analysed by the chief researcher for various measures of food intake that were of interest to this research. This information was extracted by thorough repeated examination of the diaries.

The number of eating/drinking episodes per day was calculated. An episode was defined as an occasion when drinks, foods or both were consumed at each occasion, with at least a 30 minute period between the previous consumption of food/drinks. This was the same method as used by Habibian et al (2002). Plain water and medicines were not included.

Eating events within each diary were considered and categorised as consisting of homemade foods only, processed foods only or a combination.

The amount of milk consumed was calculated for each diary, excluding milk consumed within a meal (such with breakfast cereal). This was examined for the three separate age groups due to the different recommendations for each group.

Diaries were analysed for the amount and variety of fruit and vegetables consumed over the diary period. The number of portions of fruit and vegetables offered per day was calculated using reference values of a toddler-sized portion (Infant and Toddler Forum, 2010). Dried fruits were included, as was up to one portion of pure fruit juice per day. Potatoes were not included, as they are considered part of the fibre and starch food group by the Infant and Toddler forum, neither were processed foods. The total number of different fruit and vegetables offered to the child during the three day period was calculated from the diaries.

The number of eating/drinking events that contained NMES-containing food or drink was calculated. The frequency of appearance of the most common NMES-containing sources over the three day period was calculated, for the different age groups to examine when different food types were introduced and became widely consumed.

Again, current recommendations from clinical guidelines from health agencies listed in section 4.9.2 were used as reference points from which to compare the participants' responses and feeding behaviour. Also, analysis of the behaviours were conducted with comparison of different socio-economic groups (based on SIMD, Education, NS-SEC) to illicit any differences between groups.

4.9.5.3 Complex nutritional analysis

Thorough detailed nutritional analysis of the diaries was conducted by a Nutrition PhD degree student at Glasgow Caledonian University. Completed diary content was analysed using nutrient analysis software (WISP Version 3).

WISP (Weighed Intake analysis Software Package) is a programme designed to provide a full nutrient analysis of intake data collected in a food diary or weighed intake record. The program takes in a series of food codes from the Royal Society for Chemistry 6th Edition data bank of the Composition of Foods (Food Standards Agency, 2002) or other data sources as ordered, and weights in grams. The full databank contains

approximately 5,000 food records and up to 120 nutrients. The WISP programme's main input function allows a list of foods and their weights to be entered in the computer.

Data obtained from the participants had to be as descriptively and quantitatively accurate as possible. The data entry procedure depended on whether a food code was currently in the database. If the food existed within the database, the corresponding food code was entered with the weight in grams. Foods not in the database were assigned a new food code and added to the database.

In terms of homemade foods, reported in the diet diaries, the recipe entry was used to add these foods to the database after breaking them down into their individual ingredients. In some cases, a senior nutritionist had to use their judgement in making appropriate assumptions about the relative quantities of ingredients within a homemade recipe. WISP also allowed entry of the nutrient data of commercial manufactured products, obtained from product labels. Once all the foods and their weights were entered, the completed diary record was analysed by the programme to give output nutrient data of the dietary content. The results of all the diaries were analysed using SPSS for Windows (version 16.0).

4.10 Statistical Analysis

All data management and analyses were performed in SPSS for Windows (version 16.0). Error and consistency checking was conducted using histograms, frequency distributions and cross-tabulation to ensure quality of the data.

Due to the relatively small sample, categorical variables were collapsed as follows:

SIMD quintile (3 groups): SIMD Q1 & Q2 combined; SIMD Q3; SIMD Q4 & Q5 combined.

Education of parent (2 groups): Standard education: Less than 14 years of full time education, with a level of education attained no higher than college of further education; Higher education: 14 or more years of full time education, with a level of education attained of college of further education, university or postgraduate studies.

Breastfeeding (3 groups): Not initiated/ breastfed up to two months/ breastfed beyond two months

Age of introducing solid foods (3 groups): Before four months/ between four and six months/ from six months

If teeth present, toothbrushing each day (2 groups): Yes/No

4.10.1 Descriptive Statistics

Frequency distributions were produced for categorical (nominal) data. Means and standard deviations were used to summarise continuous data that were symmetrically distributed, whereas medians, quartiles (Q1, Q3) and range (min, max) were used for skewed data.

4.10.2 Univariable analyses

Associations between two categorical variables were analysed using cross-tabulations and chi-squared statistics or Fisher's exact test (when expected cell sizes <5). Student's t-tests and Analysis Of Variance (ANOVA) were used when comparing means between two or more groups when the data were normally distributed. Mann-Whitney U-test and Kruskal Wallis tests were used when the outcome data were skewed. As the sample size was small, this study had low power to detect statistically significant differences between groups, nonetheless, p-values are presented for all analyses, with attention being paid to effect size rather than p-value alone.

Chapter 5- Results

5.1 Recruitment

5.1.1 Recruitment analysis

Recruitment took place between April and September 2010. A total of 83 eligible participants (referring to the interviewed parent/carer) were identified from the health visitor caseload, as having a child of the correct age group and fulfilling the selection criteria. They were contacted by the process described in section 4.5. Figure 5.1 illustrates the recruitment process and the final number of study participants.

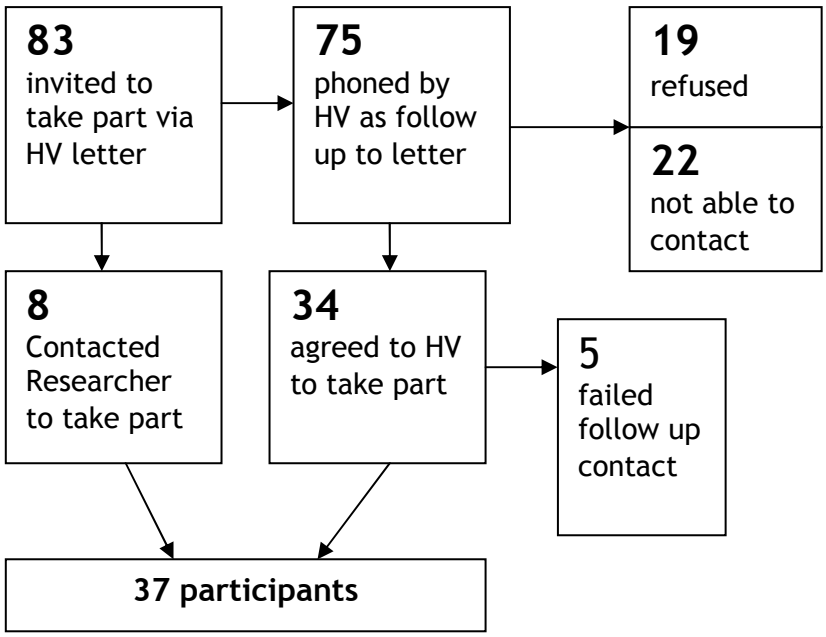

Figure 5-1 Flow diagram showing recruitment pathway

5.1.2 Participant engagement

Of the 83 families eligible for participation, 37 were recruited, and 19 refused to participate at first contact with health visitor. The reasons for refusal to participate in the study given to the health visitor included work commitments, holidays and moving house. Despite multiple attempts, it was not possible to contact 22 parents/carers (27% of total eligible). The reasons why 22 parents/carers could not be contacted by telephone were either not answering the telephone (though the health visitor tried on up to three occasions) or the phone number was no longer in service. Five parents/carers either refused or were uncontactable at the point of contact with the

researcher, giving 23 refusers and 23 uncontactables, as shown in table 5.1. Out of the total number that could be contacted, recruitment rate was 62% (37/60).

5.1.3 Characteristics of the study participants compared to the refuser and uncontactable groups

Only limited demographic information was available for the refuser and uncontactable groups. This included: age of child, position of study child in family, age of mother (at present and at delivery of first child), SIMD quintile (obtained from postcodes) and level of health visitor support. Table 5.1 compares the demographic characteristics of the participant group with the refuser and uncontactable groups to assess whether the study participants were representative of those eligible for the study.

Children of participants were more likely to be in the six-month age group than the uncontactables (46% compared to 18%). The older the child, the more difficult it was to contact the parent (32% of uncontactables were 18-months old, compared to 16% of participants).

Children of participants were less likely to be first born (24%) compared to the refusers (52%) and uncontactables (48%). There was no statistically significant difference in the median age of the mothers recruited to the study and those that refused or were uncontactable, however mothers who participated in the study, appeared to have their first child later than the other groups by two years.

Slightly more uncontactables required more than core health visitor support (36%) compared to the participants (30%) and refusers (30%). Participants were more likely to live in a less deprived area (35% in SIMD Q4 and Q5, compared to 17% refusers and 14% uncontactables).

	Participants	Refusers	Uncontactables	P-value[3]
N total	37	23	22	
Age group of child %(n)				0.107
6 months	45.9 (17)	42.1 (8)	18.2 (4)	
12 months	37.8 (14)	52.6 (13)	50.0 (11)	
18 months	16.2 (6)	5.3 (2)	31.8 (7)	
Position of child in family %(n)				0.140
1st born	24.3 (9)	52.4 (12)	47.8 (10)	
2nd born	48.6 (18)	33.3 (7)	26.1 (6)	
> 2nd	27.0 (10)	14.3 (3)	26.1 (6)	
Median age of mother [Q1, Q3]	29 [26.0, 33.0]	28 [23.8, 31.3]	28.5 [23.0, 34.0]	0.482[4]
Median age of mother at first delivery [Q1, Q3]	25 [19.3, 28.0]	23.5 [19.0, 27.3]	22 [20.0, 27.5]	0.688[4]
SIMD Quintiles %(n)				0.702
Q1 & Q2 (most deprived)	37.8 (14)	56.5 (13)	57.1 (12)	
Q3	27.0 (10)	26.1 (6)	28.6 (6)	
Q4 & Q5 (least deprived)	35.1 (13)	17.4 (4)	14.3 (3)	
Support level %(n)				0.802
1 – Core	70.3 (26)	69.6 (16)	63.6 (14)	
2 – Additional	24.3 (9)	30.4 (7)	31.8 (7)	
3 – Intensive	5.4 (2)	0 (0)	4.5 (1)	

Table 5-1 Comparison of study participants with non-participants

Casenotes were missing for one uncontactable (not included in the total) and were incomplete in two cases (position of child-refuser, postcode to give SIMD-uncontactable).

[3] Pearson's Chi-square test except where otherwise stated

[4] Kruskall-Wallis test

5.2 Socio-demographic profile of participants

For those who participated, a parent profile questionnaire (Appendix 5) was completed, which collated more detailed social and demographic information on the 37 participants.

5.2.1 Family circumstances

Eighty-six percent (n=32) of children participating in the study were living in a household with two parent figures. The main contact in the study was the mother of the child (36 out of 37), except one six-month old child who lived with the father, and was the contact. Including this child, 14% (n=5) of the children lived in sole parent families. Eight percent (n=3) of the children were living with the participating parent in their grandparent's house. The current number of children in the family of the subject child varied from one to five, as shown below in Figure 5-2.

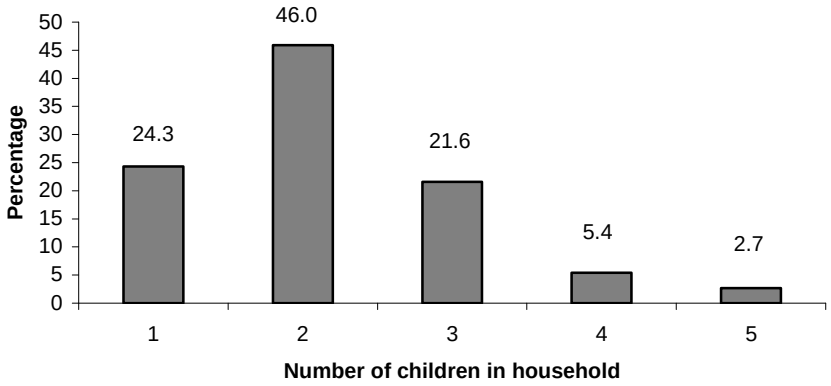

Figure 5-2 Bar chart showing the distribution of the number of children of the participants

5.2.2 Socio-economic analysis

Socio-economic characteristics of the participants were obtained by the parent profile questionnaire (Appendix 5) and analysis of these followed following the methods described in sections 4.9.1 and 4.10.

5.2.2.1 Scottish Index of Multiple Deprivation

The distribution of the participants according to SIMD is shown in Figure 5-3, and this was relatively evenly spread across the SIMD quintiles. Groups were collapsed as described in section 4.10.

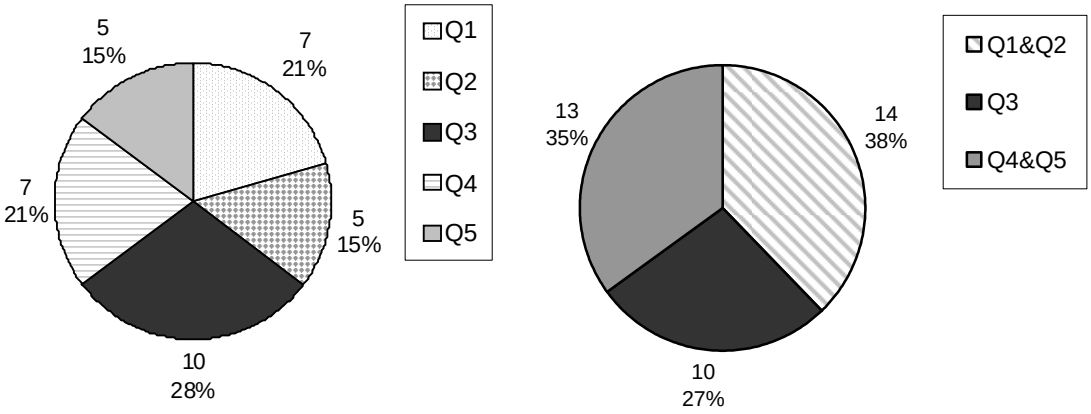

Figure 5-3 Pie chart comparing SIMD quintiles of participants and the collapsed grouping into three SIMD groups

5.2.2.2 Education of the parent

Figure 5-4 presents the distribution of the highest level of education achieved by participants. The number of completed years of full time education ranged from 10 to 21, with a median of 14. This conveys that, starting at the age of five years, the median age of leaving education was 19 years.

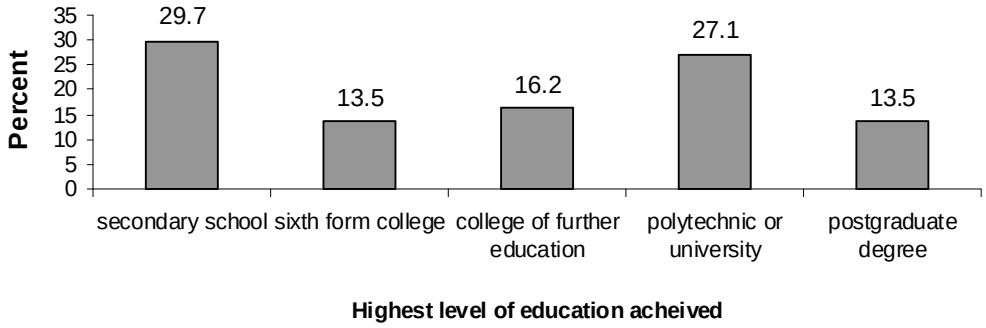

Figure 5-4 Bar chart showing the level of education achieved by the participant

Collapsing of these groups using the method described in section 4.10 led to two equal sized groups of 18 participants, classified as either having a standard level of education, or a higher level of education. These two groups will be used for comparison in further analyses.

5.2.2.3 Employment

The current or last occupation of the participant and their partner (if living in the household) were analysed using the standard occupation classification (SOC) (described

in section 4.9.1.2). The distribution of these occupation codes is illustrated in Figures 5-5 and 5-6.

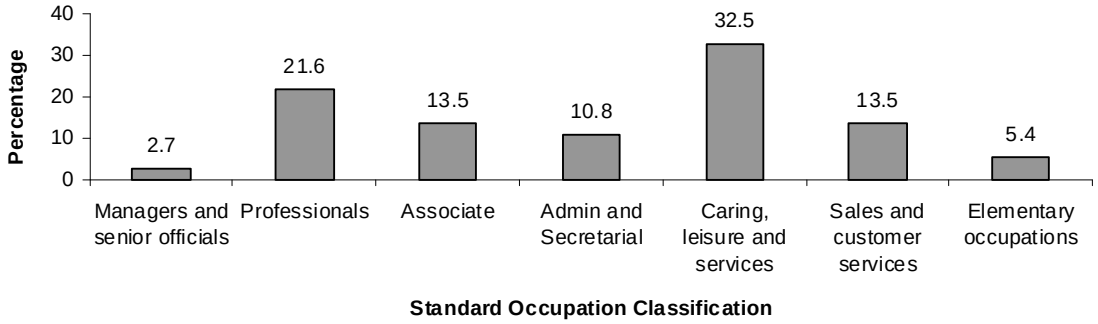

Figure 5-5 Bar chart illustrating the occupations of the mother in the participant household.

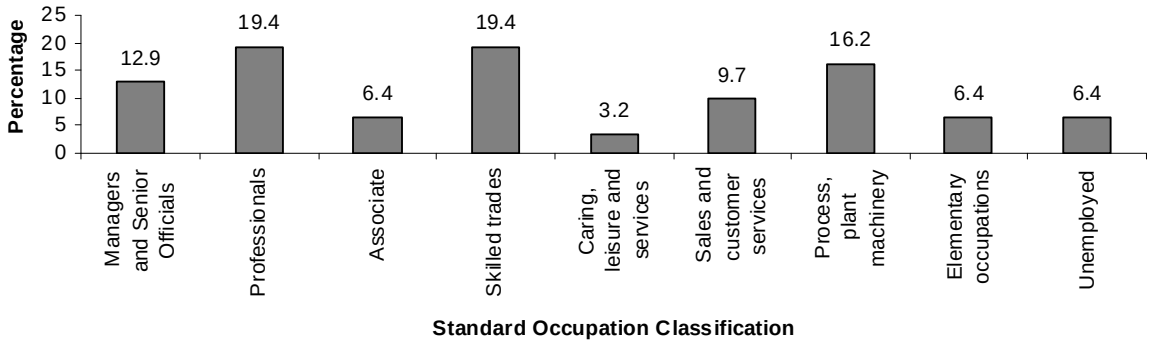

Figure 5-6 Bar chart illustrating the occupations of the participant's partner in the participant household.

These groups were collapsed using the method described in section 4.9.1.2, to assign a household occupation code according to the National Statistics socio-economic classification (NS-SEC) grouping system. These groups are shown in Figure 5.7, illustrating an even distribution of the participants' households into the three NS-SEC classes of higher managerial, administrative and professional occupations (NS-SEC 1), intermediate occupations (NS-SEC 2), and routine and manual occupations (NS-SEC 3). There were four participants that could not be assigned to one of these three groups and according to the classification were separately classified as: * those who have never worked or have been long-term unemployed.

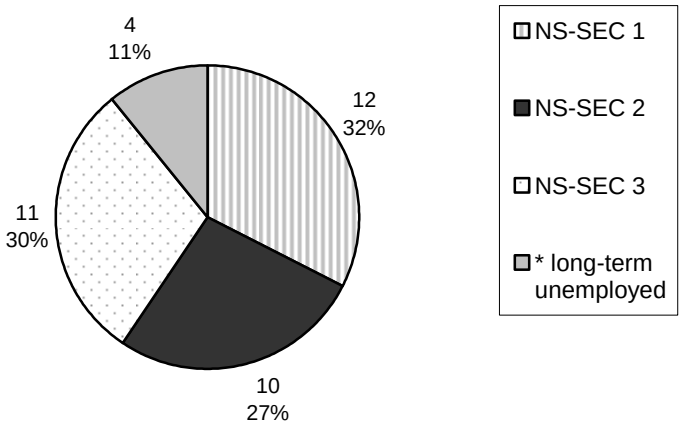

Figure 5-7 Pie-chart illustrating the distribution of NS-SEC categories of household occupation in the participants

5.2.2.4 Household Income

Figure 5-8 demonstrates the range of gross annual income in the participating households, and figure 5-9 shows the proportion of income derived from benefits in these households.

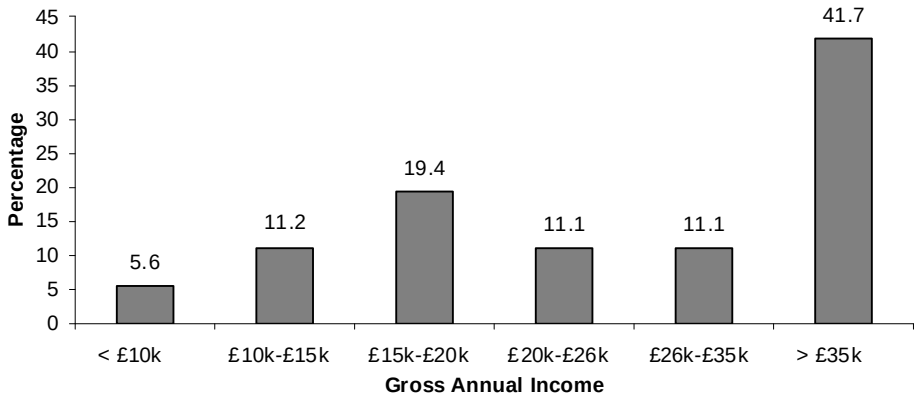

Figure 5-8 Bar chart showing participants' household gross annual income

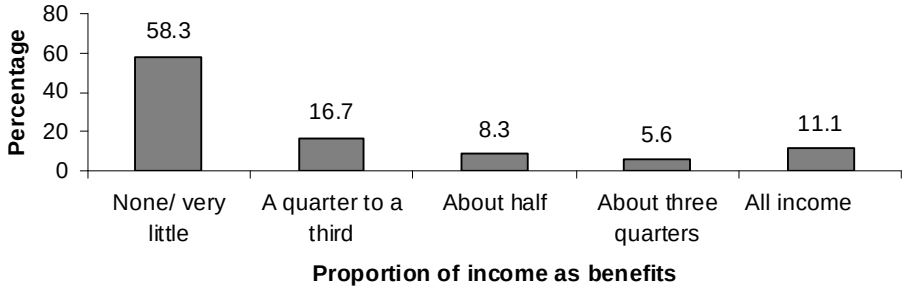

Figure 5-9 Bar chart showing the participants' income from benefits as a proportion of total income

There is an association between income and amount received in benefits, with the lowest gross household income receiving the greatest proportion of that income as benefits (Chi-square p= 0.003).

5.2.3 Comparison of SIMD with other socio-economic factors

Comparison of different indicators of socio-economic position with SIMD was carried out to assess if SIMD is a suitable measure of deprivation and scale of socio-economic status, to be used in this study (within Dumfries and Galloway). Due to the varying urban and rural localities, and the small number of participants, it needs to be determined if SIMD will accurately describe the socio-economic differences between participants. The SIMD quintiles and three collapsed groups (Q1 and Q2; Q3; Q4 and Q5) were used to compare the participants' individual socio-economic factors with the area-based measure of socio-economic position. Table 5-2 shows the relationship of SIMD with socio-demographic variables obtained by the parent profile questionnaire (Appendix 5).

5.2.3.1 SIMD and education of participant

There was a clear relationship between SIMD quintile and number of years of education. No participant living in SIMD Q1 completed more than the total mean of 14 years, and no participant living in SIMD Q5 completed less than 15 years. Table 5-2 shows the obvious relationship between SIMD and the highest level of education achieved by participants, with 63% (n=10) of whose who received education up to sixth form college living in SIMD quintiles Q1 and Q2, compared to 8% (n=1) of participants living in SIMD Q4 and Q5. Comparing the collapsed education groups of standard and higher education, there was an obvious relationship with SIMD, with those attaining a higher education more likely live in a less deprived area (chi-square p=0.016), illustrated in Figure 5-10.

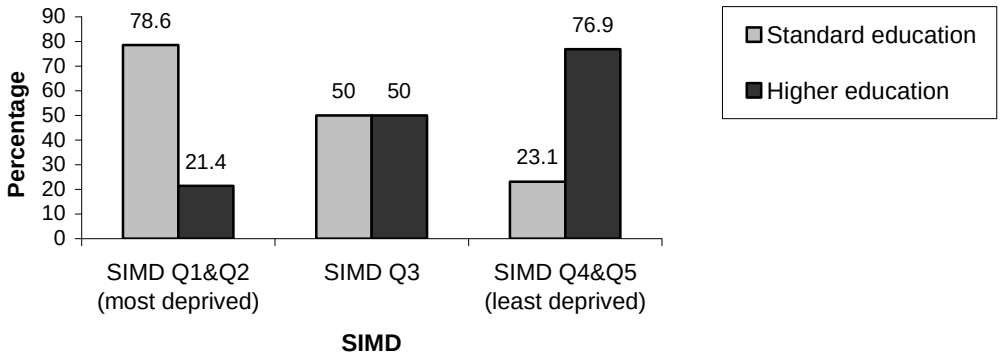

Figure 5-10 Bar chart illustrating the relationship between SIMD and level of education acheived

	SIMD Q1 & Q2 (most deprived)	**SIMD Q3**	**SIMD Q4 & Q5 (least deprived)**	P value[5]
N Participants	14	10	13	
SUPPORT LEVEL % (n)				0.230
1 – Core	50 (7)	80 (8)	84.6 (11)	
2 – Additional	42.9 (6)	20 (2)	7.7 (1)	
3 – Intensive	7.1 (1)	0	7.7 (1)	
Median age of mother [Q1, Q3]	27.5 [22.8, 33.5]	27.5 [26.0, 33.0]	32.0 [28.3, 35.3]	0.238[6]
Median age of mother at 1st delivery [Q1, Q3]	19.5 [19.0, 25.3]	24.5 [21.0, 27.3]	28.0 [27.0, 30.8]	0.005[6]
N Single parents	3	0	2	
Mothers who smoke % (n)	35.7% (5)	10% (1)	8.3% (1)	0.125
Mother's number of years in full time education (mean)	12.6	13.9	16.3	0.229
Mother's level of education attainment % (n)				0.083
Secondary school	42.9 (6)	30 (3)	7.7 (1)	
Sixth form college	28.5 (4)	10 (1)	0	
College of further education	14.3 (2)	20 (2)	15.4 (2)	
University	14.3 (2)	30 (3)	38.4 (5)	
Postgraduate studies	0	10 (1)	30.8 (4)	

Table 5-2 Comparison of SIMD groups with individual socio-demographic characteristics of the study participants

[5] Pearson Chi-square test except where stated

[6] Kruskall-Wallis test

5.2.3.2 SIMD and employment

Figures 5-11 and 5-12 illustrate the relationship between SIMD and SOC of the participating household.

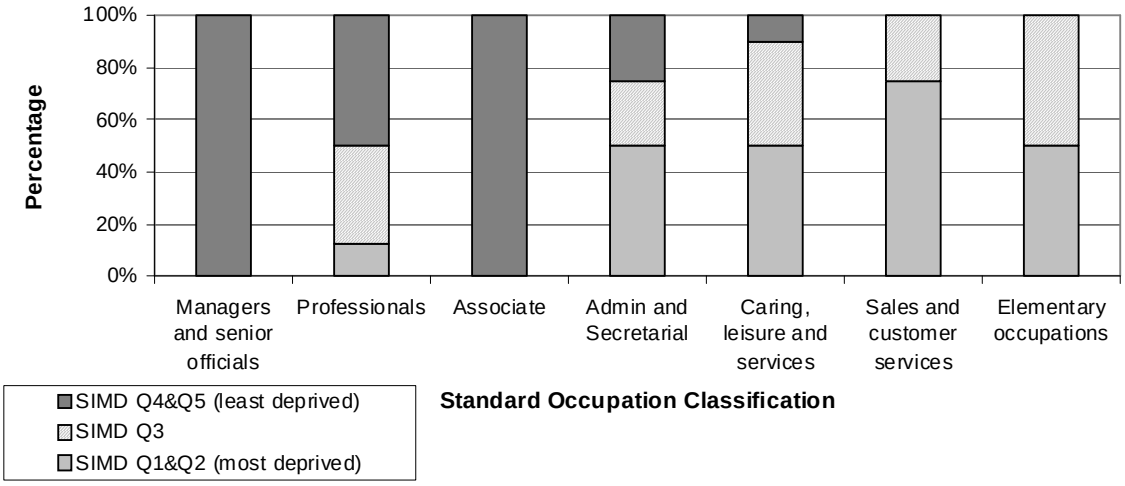

Figure 5-11 Bar chart illustrating the distribution of occupation of the mother in the participant household sub-divided by SIMD.

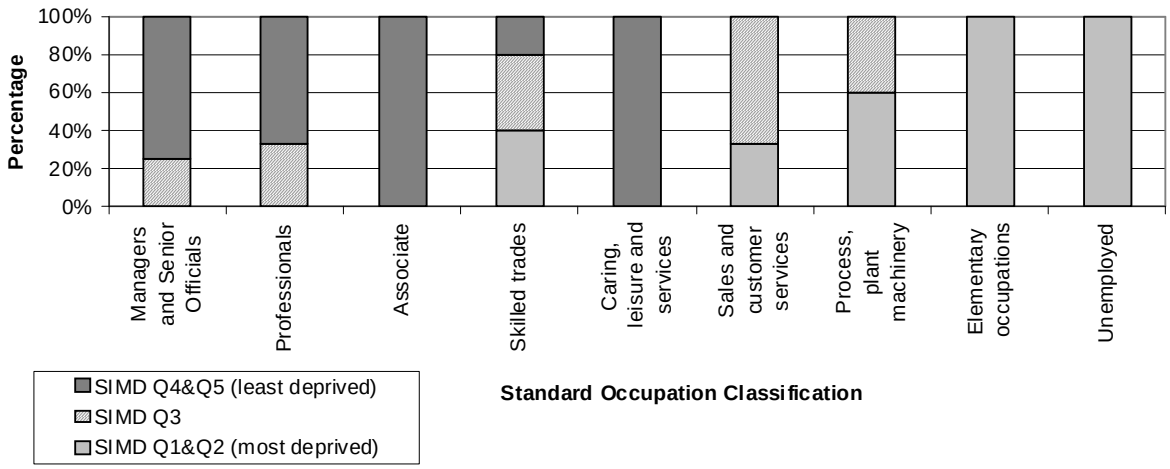

Figure 5-12 Bar chart illustrating the distribution of occupation of the father/mother's partner in the participant household sub-divided by SIMD.

These bar charts demonstrate that participants living in the higher SIMD quintiles work in more skilled, professional occupations, whereas the lower SIMD quintile inhabitants are more likely to be unemployed or in less skilled occupations. When comparing the collapsed NS-SEC groups to SIMD, figure 5-13 shows the association between SIMD and NS-SEC (chi-square p=0.017). Those with a higher NS-SEC score tend to live in less

deprived areas (63% of NS-SEC 1 live in SIMD Q4 and Q5), whilst 100% of those categorised as long term unemployed live in the most deprived areas, as well as the majority (64%) of the participants in routine and manual occupations (NS-SEC 3).

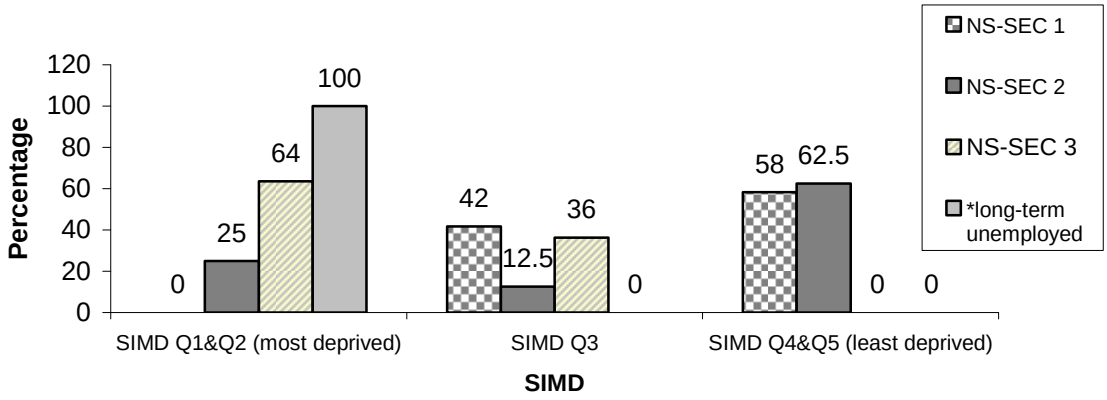

Figure 5-13 Bar chart illustrating the relationship between SIMD and NS-SEC classification

5.2.3.3 SIMD and household income

Table 5-3 shows the relationship of SIMD with household income and benefits received.

	SIMD Q1 & Q2 (most deprived)	**SIMD Q3**	**SIMD Q4 & Q5 (least deprived)**	p-value[7]
Gross Annual Income % (n)				0.010
< £15,000	30.8 (4)	20 (2)	0	
£15,000-£25,000	61.5 (8)	0	23.1 (3)	
£26,000-£35,000	7.7 (1)	20 (2)	7.7 (1)	
> £35,000	0	60 (6)	69.2 (9)	
Proportion of Income from Benefits % (n)				0.052
None/very little	23.1 (3)	80 (8)	76.9 (10)	
One quarter- third	15.4 (2)	20 (2)	15.4 (2)	
Half	23.1 (3)	0	0	
Three quarters	15.4 (2)	0	0	
All of income	23.1 (3)	0	7.7 (1)	

Table 5-3 The relationship between SIMD and household income and the proportion of this income derived from benefits

[7] Pearson's Chi-square test

Seventy-five percent of participants living in SIMD Q4 and Q5 reported a gross annual household income of over £35,000, compared to no participants in SIMD Q1 and Q2. Twenty-seven percent of participants living in SIMD Q1 and Q2 reported a gross annual income of less than £15,000 compared to no participants in SIMD Q4 and Q5 (p=0.01). Participants living in more deprived areas receive a larger proportion of their income from benefits than participants in less deprived areas. Eighty-three percent of participants living in SIMD Q4 and Q5 received only the minimum government benefits for child benefit (which accounted for a negligible proportion of total household income), compared to 64% of participants living in SIMD Q1 and Q2 having at least half of the household income deriving from government benefits.

5.2.4 Summary of findings

For this study population, SIMD shows a close relationship with the individual measures of socio-economic status, and collectively they describe the socio-economic characteristics of the population. For analysis of the socio-economic differences in the dietary behaviour described by the introductory diet questionnaires and diet diaries, SIMD is a suitable measure to compare the participants. Also, NS-SEC will be used as an individual-based measure of socio-economic position, to examine the effect of household occupation on dietary behaviour, as well as the education of the interviewed parent (the primary person completing the diaries). The questions asked about household income do not show a sufficiently even distribution among the participants to collapse the groups and use in further analysis, but the close relationship with SIMD, shows that using SIMD as a measure will allow for consideration that those in more deprived areas (SIMD Q1 and Q2) have a lower household income and greater reliance on benefits than those in less deprived areas (SIMD Q4 and Q5).

5.3 Practical utility of the dietary assessment tool

5.3.1 Practicalities of diary administration

5.3.1.1 Arrangements

During the first phone call, a meeting was arranged between the participating parent and researcher. This was at the participant's house in all cases except two, once when it was at the grandparents' house where the child was looked after during the day, at a time when the participant was picking up the child, and once at the workplace of the participant. The follow-up meeting to collect the diary was made at this visit, usually for the same time the following week if convenient.

5.3.1.2 Missed appointments

On four occasions the participant was not present at the arranged time for the first meeting and so further telephone contact had to be made. Similarly, for the follow-up meeting, number of missed visits was four. At this stage, one of the participants dropped out of the study due to missed visits and being unable to contact her. Text messages to remind participants of visits were particularly helpful for those who missed earlier appointments, or requested it when mentioned.

5.3.1.3 Length of appointments

The first appointment was approximately 15-20 minutes in length, which involved introductions and general conversation, explanation of the study and the participant's involvement. Approximately five minutes were spent interviewing the parent/carer to complete the weaning questionnaire and parent profile questionnaire. Also five minutes were spent giving instructions on completion of the diet diary.

The second appointment was approximately five to 10 minutes in length, to check the diary, gain informal feedback, and thank the parent for their involvement in the study.

5.3.1.4 Time and cost implications

The time spent by the researcher during participant engagement and analysing the data, and the implications of this on the practical utility of the diet diary within the Childsmile programme is discussed in detail in section 6.4.2 and 6.4.5.

5.3.2 Compliance with diary completion

5.3.2.1 Length of time

Participants were asked to fill in the diary on three consecutive days if possible. 70.3% (n=26) complied with this, completing the diary over a three day period. 18.9% (n=7) missed a day, and so took four days to complete the diary. Two diaries were completed over an 11 day period. One participant completed only one day of the diary, citing family reasons preventing further days being recorded. One participant did not return the diary, as they had withdrawn from the study.

5.3.2.2 Completeness of the diet diaries

The content of the diaries were examined for amount and quality of detail recorded, and each diary was given a ranking of completeness as described in section 4.9.3.1. Eighty-one percent (n=30) of participants completed the diary to a very high standard, with a ranking of 100% complete, 8.1% (n=3) completed 80% of the diary requirements, and 8.1% (n=3) completed between 20% and 60% of the diary. One participant did not complete the diary at all. They and the participant who completed only one day of the diary (ranked 20% completeness) both lived in the most deprived SIMD quintile.

5.3.2.3 Number of people involved in completing each diary

Sixty-seven percent (66.7%; n=24) of 36 completed diaries had only the parent involved directly in the study completing the diary. Twenty-five percent (n=9) had two people making entries in the diary, and 8.3% (n=3) had three. The other people filling in the diary were parents, grandparents, and childminders. The quality and completeness of the diaries was not affected by the number of people filling in the diary. All the diaries filled in by three people were given a ranking of 100% completeness, as was 78% (n=7) of the diaries completed by two people. This was very similar to diaries completed by one person, with 79% (n=19) of these diaries ranked 100% complete.

5.3.2.4 Socio-economic differences and completion of the diary

Excluding the two cases discussed above (one participant completed only one day, and one did not return the diary), there were no differences observed in any of the measures of practical utility (adherence to arranged appointments, number of days over which the diary was completed, completeness of the information recorded in the diary and number of people involved) and the socio-economic status of the participants, according to SIMD and occupation or education attained.

5.3.3 Qualitative analysis of attitudes towards the acceptability of the diary and dietary assessment

Qualitative analysis was performed following feedback discussion with the participants, using the methods described in section 4.9.4.1.

5.3.3.1 Feedback from participants

Positive comments about the diary:

Approximately 85% of the mothers had no complications with completion of the diary. They found it "*straight forward*", "*easy to follow*" and knew what they had to do from the verbal instructions. They reported that it was "*easy to fill in*", "*not difficult*", "*not complicated at all*", and "*was no bother*" or "*wasn't a problem*". The majority "*filled it in as they went along*" and as they fed, and claimed "*it just took a couple of minutes while eating*", "*no time at all*" or "*only 10 minutes of the day*" and they "*checked it at end of day*". One mother was now filling out a diet diary for herself given by her General Medical Practitioner, and commented that her diary was "*awful compared to this* [baby's diary], *which has much more room to write and simple, but allows more detail as well*".

Negative comments about the diary:

One mother admitted that at first she "*had thought 'oh no, this is going to be hard work' but actually found it was fine*" and other comments included finding the "*quantities for homemade food difficult to judge*", "*looking for the names on labels was tricky*", and difficulty "*remembering to put medicines down*". One mother reported forgetting a meal and adding it to the diary at the end of the day. Two mothers commented that they would have preferred to have the food and drink pages combined, so "*didn't have to swap between pages*", and two would have liked more room to write in detail. One mother would have liked the diary to be able to fold in half, "*to fit in nappy bag when going out*". One mother, who works full time, reported that the diary "*was quite time consuming*" as the other carers wrote down what they gave and she "*had to write it up at night*".

How did they find the length of the diary period?

Many mothers stated that "*once in the routine, completing the diary was fine*" and they could have "*happily done it for longer*". Some mothers reported that three days was long enough to give an accurate representation of meals, and said it "*was the perfect*

length of time", "*a good length of time*" that "*three days was fine to show the routine, and one week might have meant not as many mums agreeing to do it*" and "*three days was probably long enough*" . Conversely, an equal number of mothers would have preferred to do the diary for longer, as they thought "*more days would give a broader picture, even though* [she] *eats mostly the same thing*", "*five days would be better, to show more variety in the diet*" and that they could "*do it for five days with no more hassle*" because "*the first day was hardest, then when got it sorted in head and the way to do it became easier, the third day was a doddle*". Some mothers would have liked to do the diary for a week, as they thought it "*would be better*", "*three days doesn't show as much variety as over a week*" and "*a whole week, when you couldn't choose the days, would show everything*".

Were the diary days typical?

The majority of days recorded in the diaries were typical of what the participant ate. The reasons for atypical days were when a mother felt her child "*wasn't eating much, but drinking more, because of the hot weather*", "*was a little ill on the first two days, because of teething, he wasn't having a full bottle of milk*" or "*not eating as much hard foods*" because of teething. Also, one mother said she was trying to introduce a cup, and so her child "*wasn't drinking as much, as trying to get used to it*". One child "*had his jags*" and so didn't eat so much, and one celebrated his sibling's birthday, and so had an atypical diet. One mother admitted deliberately missing a day because her child was staying with his grandparents, and she knew "*he would get fed lots of sweeties and junk food, and* [she] *didn't want it to look bad*". She then said that he didn't often stay with them, so it would be an atypical diet. Another mother avoided completing the diary on days when they go out (two days a week), as the diary was "*a bit too large to carry around*".

Was the diary any help to the parents/carer?

A few of the mothers participating reported that the diary made them more aware of the feeding habits of their child, and for the six-month old age group, the rapid change in diet when weaning. It showed one that her child "*didn't eat much, as was only weaned at six months*", others commented on the "*change in amounts rapidly*" and how the child was "*eating so much more since filling in the diary*" (one week). It helped one mother realise she was "*feeding every four hours rather than on demand*" and another to confirm what she had thought about her baby "*having longer feeds in the night*". The weighing of food to record in the diary helped one mother "*know the portion sizes for future feeds*" and two mothers with babies that had not been putting on weight had

tried to keep personal diaries before to see if eliminating wheat from the diet would help.

Did they find anything helped with completion?

One mother reported having "*the scales out on the side set up to weigh food just before feeding*" and another "*marked* [the] *cup with lines for ml*" to make it easier for her, "*rather than measure each time*". Breastfeeding mothers kept the diary by the bed at night to record night feeds, and one mother kept the diary on the television to remind her to fill it in. For a child that attended nursery and takes a packed lunch, the mother "*wrote down what was in the lunch box*" on paper and asked the nursery staff to fill in the diary with the time and what was eaten. When one mother went out one day with her child, but without the diary, she "*wrote everything down on a memo app* [application] *on the phone*" and copied it up later. Two other mothers reported "*noting things down when feeding, and wrote it up later*", "*to make it clear*". When one sibling scribbled on some pages of a diary, the mother photocopied other pages and used these, in order to complete the three days.

How do they feel about a paper method of data collection compared to computer?

When asked how they would feel about filling out an online diary, only one mother gave positive comments, saying that it would have been eco-friendly and she would have not worried about "*handwriting and spelling problems*". Most mothers said that using a computer would have "*been more time-consuming*", and although most reported that they had a computer, and would have still participated, it "*would have took longer*" and been "*more of a faff*". They commented that they "*would have done it at the end of the day*", "*much more difficult to fill in as you go along, and difficult to take around with you*" and so it would "*be twice as much work, making a note on paper, then copying it up*". All mothers said that the paper method was much quicker and convenient, as "*it would take a lot longer turning on the computer to do something on there, compared to the paper sitting on the kitchen table*" and "*ages to complete each entry*". One mother said she "*can't use the computer until the kids are asleep, because they mess with it*" and another said with all the family sharing the computer, it would be "*hard to get chance to use it*". With the possibility of texting, mothers thought "*it would be difficult to get all the detail down*", that "*it would take longer than writing on paper*" and the paper method is "*fine as it is, easy and straight-forward*".

5.3.3.2 Focus groups

The success of the focus groups was limited by the number of attendees. Unfortunately although most participants felt happy to be contacted for invitation to the focus groups, due to the timing of these groups on weekdays (some mothers had now returned to work after maternity leave), over the school mid-term holidays, and personal issues of the participants, attendance was very poor. One participant attended the first focus group, held at the Dumfries and Galloway Royal Infirmary, and two participants attended the last focus group, held at Lochside education centre. The recordings of the sessions were transcribed by the primary researcher as described in section 4.9.4.2, and the opinions of the attendees, in reference to prompting questions, are described below.

When asked how easy they found completing the diary:

All three attendees found the diary was "*easy to follow*" and would have found it as easy to complete if they had not received the verbal instructions from the researcher when given the diary:

"..yeah, I mean there's instructions on the page as well, it tells you exactly how to fill it out and what to do, so yeah" (Attendee 1)

When asked about any difficulties with the diary:

"..you have to break it right down to what it is, brands and white bread, brown bread, what kind of milk, and it's the breaking it down bit that made it longer, but I wouldn't have said it was difficult to do, to make it harder for anyone else to do" (Attendee 2)

"It's trying to remember what, if it's a brand it's easy enough…but when it was something you've made yourself, and it's all the things you put in…apart from that, it was fine" (Attendee 3)

When asked how they felt about the length of the diary period:

"it's kind of routine…it was practically the same, it would have become repetitive…three days is adequate, you get all the information you need…maybe up to five, but after five, personally I would have got fed up" (Attendee 2)

"three days was fine…pretty much the same, with repeating, but if you had it for longer, if it was a week, you would get the weekends and that being different" (Attendee 3)

When asked about other carers filling in the diary:

"If it had been at nursery, it's about time and remembering with looking after so many children…but they have a plan on the wall, Monday to Friday, and it tells you what they have at snack and meal time" (Attendee 1)

"…all the nursery had to do was write it, because I get a daily sheet anyway of what they've had, when they had it and all that, basically all they were doing was transferring that information onto the diary, I wasn't asking them to do anything more…" (Attendee 2)

When asked about completing the diary on the computer or by text message:

"I'm more likely to use paper and pen than texting or using a computer, it's quicker to do that, and you can have it in any room" (Attendee 1)

"…the paper way was good enough for me…if it's not broke why fix it, that kind of way…it would have been more of a chore going to the laptop, putting it on, rather than pulling out the paper and filling it in.." (Attendee 2)

"I think trying to be paperless produces more paper…if it was email or text, well my mum and dad and [partner's] mum and dad, they can't text or use a computer, so it would be written down for me to then do it" (Attendee 3)

"…I wouldn't actually want or expect [the nursery] to do something like that, I'd of had to text later…" (Attendee 2)

When asked if they gained anything from the diary experience:

"I think it's a good idea. It definitely made me aware, you know, reading what I'm actually feeding [child]" (Attendee 1)

"When you see it all written down in black and white, food wise I didn't think it was that bad, but a lot of juice, [and seeing what the grandparents gave the child when in their care] they seem to buy and spoil him" (Attendee 3)

"I didn't realise she ate as much as she did, I always thought that it was three meals and a snack, something like that, she stayed normal, but when you write it down, you see a whole lot more that they're eating, ken?" (Attendee 2)

When asked why they thought people might not take part:

"Well if someone gives their children a poor diet…well that would be a reason…but you want to help other people benefit or something like that, and it doesn't take much of your time, I would happily do it" (Attendee 2)

"I don't know why someone wouldn't want to fill it in to be honest…maybe if they feel like they're getting the finger pointed at them or something, maybe if they don't feed their child properly…I would still fill it in because if I get feedback it's just a good thing, it's going to improve things" (Attendee 1)

"…because it was for [child], you want to do it right, because you're thinking if there was something wrong, you know, it might get picked up and you would be told that it would be better if you actually did something else…" (Attendee 3)

5.3.4 Summary of findings

Over the two visits to each participant, a total of 11% (n=8) appointments were missed by the participant. This equated to approximately five hours of researcher time (included travelling time). Text messages were useful to remind participants of appointments. Delivery of verbal instructions about use of the diary took approximately five minutes, with participants reporting that they would have found the diary easy to follow without verbal instructions, but by reading the instructions on the diary. However, some participants reported complications, such as judging quantities, ingredients and remembering to add items like medicines.

Ninety percent (n=33) of participants completed the diary over three or four days. They reported that the majority of these days were typical. Ninety percent (n=33) completed the diary to a standard of over 80% complete. The number of people involved in completing a diary did not affect its level of completeness. Some participants developed their own methods and aids to help completion. Socio-economic differences of participants did not affect any of the measures of practical utility, except that the two participants to not continue through the diary period both lived in the most deprived SIMD quintile.

Most of the participant feedback was positive about how little inconvenience the diary caused to the normal daily routine. The length of the diary (number of days) seemed an appropriate length to most participants. Most felt an online web-based computer diary would not be as easy and convenient as a paper diary. Some participants mentioned how the diary had personally increased their awareness of feeding patterns, and their interest in improving their child's diet.

5.4 Dental health

This study was not primarily concerned with the current dental health of the young children involved, but of investigating potential dietary causes for poor dental health in childhood. The young age of the children suggested that very little dental disease would have been experienced, and so the dental health questions asked were limited to whether the child had teeth present yet, if they were having the teeth brushed, and if there was any food and drink intake after having teeth brushed before bedtime. The responses are compared to current recommendations from clinical guidelines, as discussed in section 4.9.2.

5.4.1 Teeth present

Teething of the first deciduous teeth begins at approximately six months of age. Of the 17 babies participating at the age of six months, 35% (n=6) were reported to have teeth present. Of the 20 children aged 12 or 18 months, 100% were reported to have teeth present.

5.4.2 Toothbrushing

Recommendation from the Childsmile care manual (Childsmile, 2007): From the time of eruption of the first tooth, toothbrushing should begin, with brushing last thing at night, and at least one other time during the day.

Recommendation from Ready Steady Baby! guidance booklet (NHS Health Scotland, 2009): From the moment their first tooth erupts, you should brush your baby's teeth. Make sure you brush their teeth last thing at night and at least once during the day.

In this study, of the six-month old babies with teeth present, only one participant reported not brushing. All other participants with children with teeth present, reported to brush their teeth daily.

5.4.3 Food/ drink after brushing

Recommendation from the Childsmile care manual (Childsmile, 2007): If an overnight bottle is required, only water should be given. Bottles made up with juice, milk, or breastmilk, contain sugars and can cause dental caries. They are particularly harmful at night, due to reduced salivary flow.

Recommendation from NICE clinical guideline (National Institute for Health and Clinical Excellence, 2008): Discourage offering baby juices or sugary drinks at bedtime.

Recommendation from Prevention and management of dental caries in children; Dental Clinical Guidance (Scottish Dental Clinical Effectiveness Programme (SDCEP) 2010): Nothing should be given after brushing teeth at night.

Participants were asked if their child had anything to eat or drink after having their teeth brushed at night. Of the six-month old group that had teeth and were brushing, four were reported to have nothing after toothbrushing, and two were breastfed. Of the 12-month old group, four had nothing after brushing, seven had a bottle of milk before bed, and three were breastfed. Of the 18-month old group, two had nothing after brushing, three had milk, and one had a supper, usually yoghurt. One occasionally had some of his older sisters' food before bed, after toothbrushing. Table 5-4 illustrates that there is no clear relationship between SIMD and the offering of food/drink after toothbrushing.

	% Participants (n) offering after brushing:			
	Nil	**Breastmilk**	**Milk bottle**	**Occasionally food**
SIMD Q1+ Q2 (most deprived)	22.3 (2)	11.1 (1)	55.5 (5)	11.1 (1)
SIMD Q3	75.0 (6)	0	12.5 (1)	12.5 (1)
SIMD Q4 + Q5 (least deprived)	14.3 (1)	28.6 (2)	57.1 (4)	0

Table 5-4 Distribution by SIMD of participants offering food/drink after brushing teeth before bedtime

5.4.4 Summary of findings

Ninety-six percent (n=25) of participants were brushing their child's teeth daily. Contrary to the guidelines, 50% (n=13) of children were having some milk (either breastfed or a bottle) after brushing teeth at night, and 8% (n=2) were often consuming food before bed. This behaviour did not show any clear relationship with SIMD.

5.5 Weaning and feeding patterns

The following section presents analysis of the dietary behaviour questions asked in face-to-face interviews with the participating parents/carers (using the introductory diet information form in Appendix 6). Weaning and feeding characteristics are examined, with reference to the current recommendations discussed in section 4.9.2, with examination of any difference in dietary behaviour in different socio-economic groups.

5.5.1 Breastfeeding

Recommendation from WHO (2001): Infants should be exclusively breastfed from birth for six months, with continuation of breastfeeding up to two years with complementary feeding.

Sixty-one percent of mothers (n=22) reported starting breastfeeding. The prevalence of reported breastfeeding decreases with increasing deprivation of participants (p= 0.006), but there is no association with reported breastfeeding and the age of the mother (p= 0.632). Figure 5-14 shows the distribution by SIMD quintile of participants reporting to have breastfed the subject child.

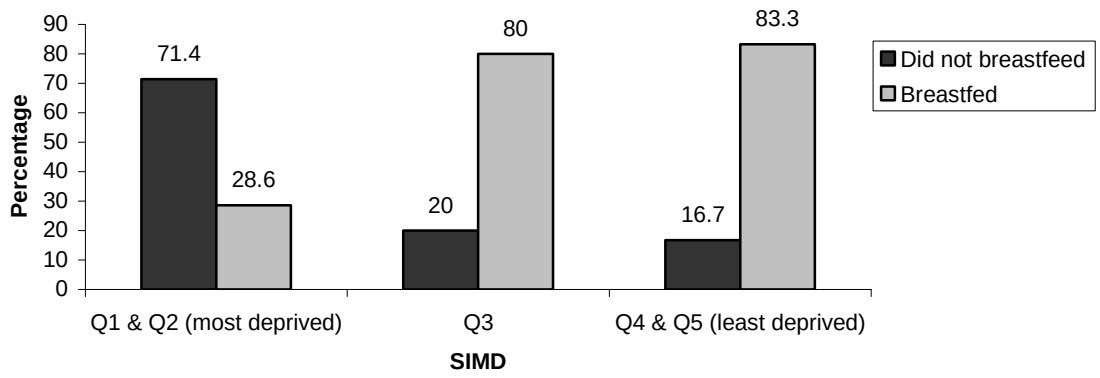

Figure 5-14 Bar chart illustrating the relationship of reported breastfeeding and SIMD

Of the participants that breastfed, the median age of stopping breastfeeding was 7.75 months (Q1=1.5, Q3=10.25). When investigating the continuation of breastfeeding up to the age of weaning, the number of participants breastfeeding beyond two months after the birth was considered. Seven participants that began breastfeeding, stopped before two months, whilst 68.2% (n=15) reported continuation of breastfeeding up to the age of weaning. Of these 15 participants, the median age of stopping or expected stopping breastfeeding was 9.0 months (Q1=7.5, Q3=12.0), with 87% (n=13) breastfeeding beyond six months. Table 5-5 highlights the relationship of reported breastfeeding with SIMD,

level of educational attainment of the interviewed participant and social class based on household occupation (NS-SEC).

There is a relationship observed between SIMD and the initiation of breastfeeding (p=0.006) and with the continuation of breastfeeding over two months (p=0.007). Seventy-one percent (n=10) of participants living in SIMD Q1 and Q2 did not breastfeed their child at all, compared to 17% of participants living in SIMD Q4 and Q5. A similar disparity was seen between participants attaining a standard education (61% did not breastfeed) compared to participants who received a higher education (17% did not breastfeed). The relationship between NS-SEC and initiation of breastfeeding and continuation of breastfeeding, is especially highlighted by the observation that 100% of households classed as long-term unemployed did not initiate breastfeeding compared to 17% of households classed as the highest occupational category.

	% Breastfeeding (n)			p- value[8]	
	Not initiated	Stopped before 2 months	Beyond 2 months	Initiated breastfeeding	Continued breastfeeding
Total	38.9 (14)	19.4 (7)	41.7 (15)		
SIMD Q1& Q2 (most deprived)	71.4 (10)	14.3 (2)	14.3 (2)	0.006	0.007
SIMD Q3	20 (2)	40 (4)	40 (4)		
SIMD Q4& Q5 (least deprived)	16.7 (2)	8.3 (1)	75 (9)		
Standard Education	61.1 (11)	22.2 (4)	16.7 (3)	0.006	0.002
Higher Education	16.7 (3)	16.7 (3)	66.6 (12)		
NS-SEC 1 (highest)	16.7 (2)	25 (3)	58.3 (7)	0.151	0.084
NS-SEC 2	30 (3)	10 (1)	60 (6)		
NS-SEC 3 (lowest)	54.5 (6)	27.3 (3)	18.2 (2)		
***long-term unemployed**	100 (3)	0	0		

Table 5-5 The relationship between reported breastfeeding and SIMD, education achieved by the participant and NS-SEC of the household

[8] Pearson's chi-square test

5.5.2 Weaning

Recommendation from WHO (2001): Infants should be exclusively breastfed from birth for six months, with complementary foods introduced from six months.

Recommendation from Ready Steady Baby! guidance booklet (NHS Health Scotland, 2009): Until six months, breast or formula milk provides all the nourishment that babies need. At six months, you can gradually introduce mashed foods (also known as 'solids'). It is not recommended to give your baby solid foods before six months.

The median age of introducing solid foods was 4.75 months, with a range of three to seven months (excluding one report of 13 months, as this was due to diet intolerance, requiring medical support with weaning). Table 5-6 shows the relationship between the age of child when solid foods were first offered with SIMD, level of educational attainment of the participant and household occupation.

	% Participants (n) introducing solid foods:			p-value[9]
	< 4 months	**4 < 6 months**	**> 6 months**	
Total	11.8 (4)	61.7 (21)	26.5 (9)	
SIMD Q1 & Q2 (most deprived)	16.7 (2)	66.6 (8)	16.7 (2)	0.203
SIMD Q3	10 (1)	70 (7)	20 (2)	
SIMD Q4 & Q5 (least deprived)	8.3 (1)	50 (6)	41.7 (5)	
Standard education	25 (4)	62.5 (10)	12.5 (2)	0.183
Higher education	0	61.1 (11)	38.9 (7)	
NS-SEC 1 (highest)	0	58.3 (7)	33.3 (5)	0.492
NS-SEC 2	20 (2)	60 (6)	20 (2)	
NS-SEC 3 (lowest)	20 (2)	70 (7)	10 (1)	
***long-term unemployed**	0	50 (1)	50 (1)	

Table 5-6 The relationship between the age of weaning and SIMD, education achieved by the participant and NS-SEC of the household

The majority of participants (62%) introduced solid foods to their child between four and six months after birth. More than twice as many children living in the least deprived areas are first given solid foods after six months than children in more deprived areas

[9] Pearson's Chi-square test

(42% in SIMD Q4 and Q5, compared to 14% in SIMD Q1, Q2 and Q3). When considering the level of educational attainment of the participant, 25% of those with a standard level of education introduced solid foods before four months, and 13% waited until after six months, compared to 39% of participants with a higher level of education (none of these weaned before four months). Also, participants in households with a managerial and professional occupation are more likely to wean onto solid foods later than those with a routine and manual occupational background. These findings echo the rates of breastfeeding and so it suggests that children who are breastfed are introduced to solid foods later. On average, participants who breastfed beyond two months began introducing solid foods to their child a mean of two weeks later than the other participants (5.2 months compared to 4.6 months).

5.5.3 First solid foods

Recommendation from the Childsmile care manual (Childsmile, 2007): Weaning should begin around six months, and start with offering babies one to two teaspoons of one smooth pureed food, at one meal a day. Good foods to start with are apple, pear, banana, cooked potato, carrot, turnip, or baby rice.

Recommendation from Ready Steady Baby! guidance booklet (NHS Health Scotland, 2009): Suitable weaning foods: baby rice mixed with your baby's usual milk; cooked and mashed vegetables; peeled and mashed banana; peeled, cooked and mashed fruit. Remember not to add any sugar or salt to your baby's food.

The most common first weaning food was baby rice, reported by 61.8% of participants as the first solids introduced. Also mentioned was mashed/pureed vegetables or fruits (16.2%), baby porridge (10.3%), rusks (8.8%), baby jars (4.4%) and in one case, soft crisps (2.9%).

Rusks, baby jars and crisps are not considered recommended first weaning foods, therefore 12% of participants are not adhering to the guidelines. Of these participants, 100% are classified as attaining a standard education and 80% reside in SIMD Q1 and Q2 (20% reside in Q3).

5.5.4 Type of milk

Two children (5.4%) were being given soya formula milk due to lactose intolerance. Soya formula milks contain glucose syrup or maltodextrins instead of lactose, and therefore are potentially more cariogenic than standard infant formulas (Bhat & Dubey, 2003; de

mazer Papa et al, 2010). It is not within the scope of this study to examine the difference in cariogenicity of different types of milk, and it was considered that lactose intolerance was not related to socio-economic measures. Therefore, these two children were treated as if taking standard infant formula milk and the dietary data extracted from the diaries was examined with the same methods as the other diaries.

5.5.5 Other drinks

Recommendation from the Childsmile care manual (Childsmile, 2007): Cooled, boiled water is the best drink to offer, in addition to breast or formula milk, and drinks between meals should be limited to these, as these are the safest drinks for teeth. Pure unsweetened fruit juice should be diluted with water, and restricted to mealtimes only. Sweetened drinks encourage a sweet tooth, have little nutritional value, and once tasted, make it difficult to get the child to accept less sweet-tasting drinks. Diluting juices containing sugars and artificial sweeteners, and sugary fizzy drinks are not recommended for infants, and definitely should not be given outside mealtimes.

Recommendation from Ready Steady Baby! guidance booklet (NHS Health Scotland, 2009): The safest drinks for your baby's teeth are milk and water.

Forty seven percent (n=8) of the six-month old group were being given fruit juice or diluting juice (including sweetened and unsweetened diluting juice) as a drink, as well as milk and water, compared to 71% of the 12-month old group and 100% of the 18-month old group. Within the six-month old group, twice as many of participants living in SIMD Q1 and Q2 had introduced drinks other than milk and water (67%, n=4) compared to participants living in SIMD Q4 and Q5 (40%, n=2). When examining the education groups, 78% (n=7) participants who attained standard education had introduced drinks other than milk and water before six months of age, compared to 25% (n=2) of participants with a higher level of education.

5.5.6 Type of drinking vessel

Recommendation from the Childsmile care manual (Childsmile, 2007): For six-month old babies, drinking from a free-flowing cup should begin to be established (for example, a tommee tippee cup). For 12 and 18-month old children, drinks should be taken from a free-flow feeder cup, and liquids from a feeding bottle should be discouraged, especially sugar-sweetened drinks.

Recommendation from NICE clinical guideline (National Institute for Health and Clinical Excellence, 2008): Offer drinks in a non-valved, free-flowing cup from age of six months to one year. Discourage feeding from a bottle from one year of age onwards.

Recommendation from Ready Steady Baby! guidance booklet (NHS Health Scotland, 2009): You can introduce a cup from six months, and aim to have your baby no longer drinking from a feeding bottle by their first birthday.

Recommendation from Ten Steps for Healthy Toddlers guidance (Infant and Toddler Forum, 2010): Bottles should be discontinued by about 12 months of age, because they can become used as a comfort, render teeth more vulnerable to dental caries and reduce appetite for other foods.

Participants were asked which type of drinking vessels they used. Of the 17 six-month old children, 94% (n=16) were using a bottle with teat. The one participant that was not using a bottle with teat was still breastfeeding. She was introducing other drinks with a plastic trainer cup with lid, like six other participants (total of 41%). The older age groups used a variety of different vessels, with 70% (n=14) reporting using two or more different types. Figure 5-15 shows the range and popularity of drinking vessels used by the 12 month and 18- month old age groups.

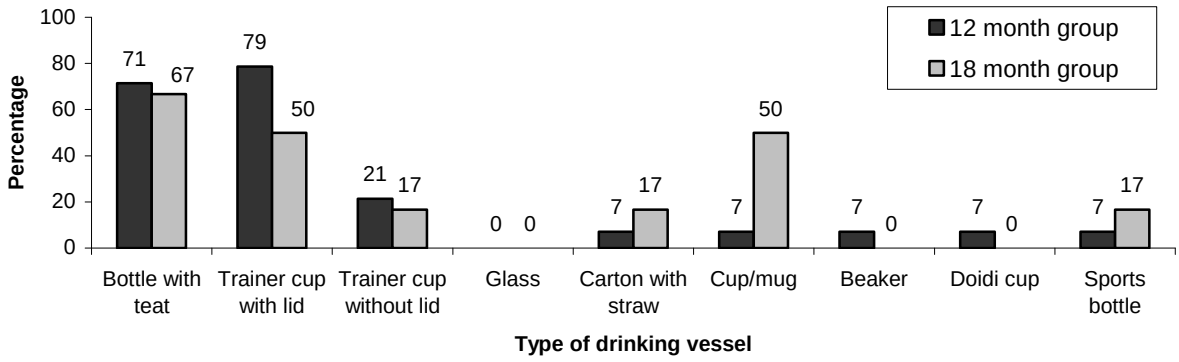

Figure 5-15 Bar chart showing the prevalence of use of different types of drinking vessels by the 12 month and 18-month old age groups

The recommended free-flowing vessels include trainer cup without lid, glass, cup/mug, beaker and doidi cup. Figure 5-15 shows that these vessels had much less prevalent use than bottles with teats and lidded trainer cups, which are not recommended beyond 12 months. Of the 12-month old children, 43% (n=6) were using free-flowing vessels for some drinks. Eighty three percent of the parents of these children had attained a higher

education, and 100% resided in SIMD Q3, Q4 or Q5. Of the 18-month old children, 67% (n=4) were using free-flowing vessels for some drinks, with no clear relationship with SIMD or education attained by the participant.

5.5.7 Medicines

Nineteen percent (n=7) of participants reported that their children took regular medicines, vitamins or drops. This was three (18%) babies at six months, two (14%) at 12 months, and two (33%) at 18 months. During the diary period, it was recorded that five babies (14%) were given medicine; in four cases it was analgesics for teething pain.

5.5.8 Summary of findings

WHO (2001) recommends all babies are exclusively breastfed until six months of age. Of the participants in this study, 39% did not initiate breastfeeding, 19% breastfed but stopped before two months and 42% followed the recommendation, breastfeeding beyond weaning age, up to a median of nine months. Participants living in a less deprived area, with a higher level of educational attainment, and/or in a household classified with a higher occupation were more likely to initiate, and continue breastfeeding.

Breastfed children were first offered solid foods an average of two weeks later than children fed formula milk. The median age of introducing solid foods was 4.75 months (over a month earlier than recommended by WHO (2001) and NHS Health Scotland (2009)). Children living in a less deprived area, with a more highly educated interviewed parent, and/or in a household classified with a higher occupation were more likely to start weaning later (though still before the recommended age).

Although milk and water are the recommended ‘safe’ drinks (Childsmile, 2007; NHS Health Scotland, 2009), 47% of six-month old babies and 71% of toddlers at 12 months and 100% at 18 months, were being given fruit juice or diluting juice. Introducing these drinks by the age of six months was more likely in households in more deprived areas and less likely by parents with a higher education. There is concern that soya infant formula milk may be an ‘unsafe’ drink, as it contains glucose rather than lactose that is present in standard formula, cows’ milk and breastmilk.

It is recommended that children are using a free-flowing cup and no longer using a feeding bottle by one year of age (Childsmile, 2007; National Institute for Health and Clinical Excellence, 2008; NHS Health Scotland, 2009; Infant and Toddler forum, 2010).

However in this study, 71% of toddlers aged 12 months and 67% aged 18 months were still using a bottle for some drinks. At 12 months, children with a more highly educated interviewed parent, and/or from a less deprived area were more likely to be using free-flowing cups for some drinks, having closer adherence to the guidelines.

5.6 Primary dietary analysis

5.6.1 Quality of the dietary information collected in the diaries

As the primary aim of the study was to investigate the practical utility of the dietary assessment tool, it was dependent on the success of the use of the diary by participants as to whether there would be sufficiently detailed data collected of a quality suitable for analysis. As discussed in section 5.3.2.2, there were high levels of completeness in the vast majority of the diaries, with useful detail of dietary behaviour in all three age groups. Therefore, it was deemed that this data was of sufficient quality to extract nutrient data (using the methods of analysis described in section 4.9.3.2) from the diary recordings, for detailed dietary assessment and comparison of the behaviour of the study participants with current recommendations and guidelines from healthcare agencies. Examination of how the dietary habits described in the diaries differ with family and socio-economic circumstances will be presented.

5.6.2 Eating episodes per day

Recommendation from NICE clinical guideline (National Institute for Health and Clinical Excellence, 2008): Provide milk and water to drink between meals (diluted fruit juice can be provided with meals- one part juice to 10 parts water).

Recommendation from Ten Steps for Healthy Toddlers guidance (Infant and Toddler Forum, 2010): Parents are advised to have a routine with three meals and two to three snacks each day. Offer six to eight drinks per day.

Recommendation from Prevention and management of dental caries in children; Dental Clinical Guidance (SDCEP, 2010): Drink only water or full-fat milk between meals.

As described in section 4.9.3.2, diaries were examined, with an episode being defined as an occasion when drinks, foods or both were consumed at each occasion, with at least a 30 minute period between the previous consumption of food/drinks. Plain water and medicines were not included.

It was found that the median number of eating/drinking episodes per day was seven [Q1=6, Q3=8]. The range was from four to a maximum of 11. There was not any obvious difference between the age groups and number of eating/drinking events per day, with the interquartile range consistent for all three age groups (Q1=6, Q3=8). Due to the very

little variation, there was no association found between the number of eating events and the level of full-time education achieved by the interviewed parent, SIMD quintile or NS-SEC of the household.

Thirty-one percent (n=11) of children were given drinks other than milk and water, at times in the day when not having a snack or meal. These drinks were either diluting juice or fresh fruit juice; no children had a fizzy drink. The number of episodes of juice drinking out-with food per day ranged from one to six. Table 5-7 shows that there was an association between all three of the socio-economic measures and the offering of diluting juice or fresh fruit juice at times when not having food, most strongly seen in the difference between parental educational attainment. Of the participants offering these drinks, 82% had a standard level of education and 18% had a higher level of education (p=0.027).

	Offering of diluting juice or fresh fruit juice when not having foods during the diary period		p-value[10]
	Yes	**No**	
Total	30.6 (11)	69.4 (25)	
SIMD Q1 & Q2 (most deprived)	38.5 (5)	61.5 (8)	0.397
SIMD Q3	40 (4)	60 (6)	
SIMD Q4 & Q5 (least deprived)	15.4 (2)	84.6 (11)	
Standard education	50 (9)	50 (9)	0.027
Higher education	11.1 (2)	88.9 (16)	
NS-SEC 1 (highest)	8.3 (1)	91.7 (11)	0.138
NS-SEC 2	30 (3)	70 (7)	
NS-SEC 3 (lowest)	45.5 (5)	54.5 (6)	
*** long-term unemployed**	66.7 (2)	33.3 (1)	

Table 5-7 The relationship between the offering of drinks other than milk and water at times when not having food, and SIMD, education achieved by the participant and NS-SEC of the household

[10] Fisher's exact test

5.6.3 Quantity of milk

Recommendation from the Childsmile care manual (Childsmile, 2007): For six-month old babies, milk feeds should gradually be reduced as solid food intake increases. Milk should still be given on waking and at bedtime, with a daily aim of 500-600mls of formula or breast milk on demand. A similar amount is recommended for 12-month old children, and from 12 months, full fat cows' milk can be given as a drink. For 18-month old children, at least 350ml of milk should be consumed daily, either on cereal or as drinks. If more than 600ml of milk is drunk per day, the child's appetite for other foods may be reduced.

Recommendation from Ten Steps for Healthy Toddlers guidance (Infant and Toddler Forum, 2010): Large volumes of milk will reduce a toddler's appetite for other foods with higher iron content, and could result in iron-deficiency anaemia. Three portions of 100-120ml of whole cows' milk is recommended for toddlers.

Table 5-8 shows the range of amounts of formula or cows' milk given as an average daily amount over the diary period. These amounts are excluding milk consumed within meals (mostly with cereal for breakfast).

	Mean daily amount of milk excluding breastmilk (ml)	Minimum (ml)	Maximum (ml)
6mths: Not breastfeeding	786	270	1200
6mths: Breastfeeding	163	0	380
12mths: Not breastfeeding	468	0	840
12mths: Breastfeeding	221	0	825
18mths: None breastfeeding	344	0	690

Table 5-8 Quantity of milk consumed over the diary period

As these values exclude milk consumed as part of a meal, it can be assumed that the daily amount is greater than these values which describe milk taken as a drink. Of the six-month old non-breastfed babies, the mean daily amount of milk consumed is greater than the recommended 500-600ml, with the maximum consumed being double the daily recommended amount. Also, for the 12 and 18-month olds, the maximum amounts given far exceed the recommendations, which are similar to the mean daily amount consumed. It is difficult to comment on the amount given to breast-fed babies, as it is not possible in this study to know the amount of breastmilk consumed. However, considerable amounts of additional milk are being given to supplement feeds, with the

maximum amount of formula or cow's milk given at 12 months exceeding the daily recommended amount, not including additional breastmilk.

5.6.4 Processed versus homemade foods

Recommendation from Ready Steady Baby! guidance booklet (NHS Health Scotland, 2009): Some babies who have a lot of pre-prepared 'baby' food which are mostly pureed take a while to get used to 'real' food with its varieties of tastes, textures and lumps.

Recommendation from the Childsmile care manual (Childsmile, 2007): No salt or sugar should be added to foods, and homemade foods are preferable to jars and packets.

Diary entries were assessed for the type of main meals given over the three-day period, whether they were exclusively homemade, or processed meals (for example jars or ready-meals), or a variety of the two types. The distribution of these categories of meals is shown in Table 5-9.

	% Participants (n) offered meals categorised as:			p-value[11]
	Homemade	**Both homemade and processed**	**Processed**	
Total	42.9 (15)	40 (14)	17.1 (6)	
SIMD Q1 & Q2 (most deprived)	25 (3)	41.7 (5)	33.3 (4)	0.180
SIMD Q3	60 (6)	30 (3)	10 (1)	
SIMD Q4 & Q5 (least deprived)	46.2 (6)	46.2 (6)	7.6 (1)	
Standard education	29.5 (5)	47 (8)	23.5 (4)	0.116
Higher education	55.6 (10)	33.3 (6)	11.1 (2)	
NS-SEC 1 (highest)	58.3 (7)	25 (3)	16.7 (2)	0.662
NS-SEC 2	30 (3)	50 (5)	20 (2)	
NS-SEC 3 (lowest)	50 (5)	40 (4)	10 (1)	
*** long-term unemployed**	0	66.7 (2)	33.3(1)	

Table 5-9 The relationship between type of meals offered and SIMD, education achieved by the participant and NS-SEC of the household

[11] Fisher's exact test

Seventeen percent (n=6) of the total study population relied solely on processed foods to feed their child, with 33% of participants residing in SIMD Q1 and Q2 giving only processed foods compared to 8% of participants residing in SIMD Q4 and Q5. This illustrates the relationship between SIMD and the reliance on processed foods. There was no clear relationship between NS-SEC and reliance on processed foods. Participants who attained higher education were more likely to provide solely homemade foods (56%) whereas those who attained a standard level of education were more likely to give some if not all processed foods during the diary period (71%).

5.6.5 Portions of fruit and vegetable

Portions per day

Recommendation from the Childsmile care manual (Childsmile, 2007): Fruit and vegetables should contribute to a third of food intake per day.

Recommendation from Ten Steps for Healthy Toddlers guidance (Infant and Toddler Forum, 2010): Offer fruit and vegetables at each mealtime and some snacks. A toddler-sized portion is described in the 10 steps document.

Diaries were analysed for the number of portions of fruit and vegetables offered per day, as described in section 4.9.3.2. An evaluation of the median portions of fruit and vegetables (including dried fruits and pure fruit juice, but not processed foods or potatoes) consumed over the three days of the diary period was calculated (shown in Table 5-10). The number of portions offered per day ranged from 0 to 12.

Due to the daily variation in the number of portions, it was deemed more accurate to report the number of portions over the three-day period. A median of seven portions over three days for the whole sample confers an average of two to three portions per day. Participants living in the most deprived areas gave, on average four fewer portions of fruit or vegetable during the diary period than participants living in the least deprived areas. Therefore they were more likely to not meet recommended number of portions per day (8% in SIMD Q1 and Q2 gave four or more portions per day compared to 31% in SIMD Q4 and Q5). Participants living with extended family (grandparents) offered the least amount of fruit and vegetables, with a median amount over the diary period of 1.0 [Q1=0, Q3=7.0]. Echoing the relationship between SIMD and number of portions, participants who had higher educational attainment offered four more portions of fruit and vegetables over the three days (33% gave four or more portions per day) than participants who had a standard level of education (30% gave no more than one portion

	Median portions consumed in three days [Q1, Q3]	p-value[12]	**% having four or more portions/day**	**% having no more one portion/day**
Total	7.0 [4.0, 11.0]		20 (7)	22.9 (8)
SIMD Q1 & Q2 (most deprived)	5.5 [2.3, 8.8]	0.339	8.3 (1)	33.3 (4)
SIMD Q3	6.5 [4.8, 118]		20 (2)	10 (1)
SIMD Q4 & Q5 (least deprived)	9.0 [4.0, 12.0]		30.8 (4)	23.1 (3)
Standard education	5.0 [2.5, 9.5]	0.039	5.88 (1)	29.4 (5)
Higher education	9.0 [5.8, 12.5]		33.3 (6)	16.7 (3)
NS-SEC 1 (highest)	9.0 [5.3, 12.0]	0.803	33.3 (4)	16.7 (2)
NS-SEC 2	7.0 [3.5, 11.8]		20 (2)	20 (2)
NS-SEC 3 (lowest)	7.5 [4.0, 11.0]		10 (1)	10 (1)
***long-term unemployed**	1.0 [1.0, 3.0]		0	100 (3)

Table 5-10 The relationship between fruit and vegetable consumption and SIMD, education achieved by the participant and NS-SEC of the household

[12] Kruskall-wallis test

per day). Participants in households with managerial and professional occupations (NS-SEC 1) gave a greater number of portions of fruit and vegetables per day than participants in households with intermediate, or routine and manual occupations, and 100% of participants who were long-term unemployed gave no more than one portion of fruit or vegetables per day (although numbers were very small).

Variety of different fruit and vegetables

The total number of different fruit and vegetables offered to the child during the three-day period was calculated from the diaries. One six-month old baby was excluded from the results, as he/she had only been introduced to foods for two weeks at the time of the diary collection, and so was not eating enough solid foods at the time of diary recording, to correctly assess what typically they will be offered when having more meals. Also, one 12-month old child was excluded as only one day of their diary was completed, so it would be inaccurate to estimate the number of different fruit and vegetables eaten over a three-day period. It would also have affected the cross-tabulations performed. The range of variety offered was from 0 to 17 different types of fruit and vegetables, with a mean of 6.8 over the three-day diary period. Table 5-11 shows the relationship between variety of fruit and vegetables offered with SIMD and level of education attainment of the interviewed participant, and the NS-SEC of the household.

Participants living in more deprived areas are less likely to offer a wider variety of fruit and vegetables than participants living in less deprived areas. Seventy-five percent of participants in SIMD Q4 and Q5 offered six or more different types of fruit or vegetables over the three-day period, compared to 42% of participants residing in SIMD Q1 and Q2. Participants living with extended family offered the least variety of fruit and vegetables, with 67% (n=2) giving no more than two types, and 33% (n=1) giving no more than five different types over three days. Participants attaining a standard level of education were more likely to give less variety (24% gave no more than two different types of fruit and vegetables over three days, compared to 6% of participants with a higher education). There was a greater variety of different fruit and vegetables given by households with managerial and professional occupations (33% offered 10 or more different types over three days) compared to households with routine and manual occupations (20%), and particularly those classed as long-term unemployed (none offered more than five different types over the three-day period).

	Different fruit and vegetables: % participants (n)				
	0-2	**3-5**	**6-9**	**10+**	p-value[13]
Total	11.8 (4)	29.4 (10)	35.3 (12)	23.5 (8)	
SIMD Q1 & Q2 (most deprived)	25 (3)	33.3 (4)	25 (3)	16.7 (2)	0.31
SIMD Q3	0	40 (4)	40 (4)	20 (2)	
SIMD Q4 & Q5 (least deprived)	8.3 (1)	16.7 (2)	41.7 (5)	33.3 (4)	
Standard education	23.5 (4)	29.4 (5)	35.3 (6)	11.8 (2)	0.05
Higher education	5.6 (1)	27.8 (5)	33.3 (6)	33.3 (6)	
NS-SEC 1 (highest)	0	25 (3)	41.7 (5)	33.3 (4)	0.35
NS-SEC 2	20 (2)	30 (3)	30 (3)	20 (2)	
NS-SEC 3 (lowest)	10 (1)	30 (3)	40 (4)	20 (2)	
*** long-term unemployed**	66.7 (2)	33.3 (1)	0	0	

Table 5-11 The relationship between variety of fruit and vegetables offered and SIMD, education achieved by the participant and NS-SEC of the household

[13] Fisher's exact test

5.6.6 Frequency of sugar intake

Recommendation from the Childsmile care manual (Childsmile, 2007): In the initial weaning stage from six months, no sugar should be added to foods given to babies. As a child reaches nine to 12 months, nutritious snacks can be given between meals, with sugar-containing foods restricted to three normal family meal times. For 18-month old children, small amounts of sweet items such as biscuits, chocolate and sweets can be given occasionally, ideally straight after a meal. Between-meal snacks should be free from added sugar. Too many sweet items can lead to a loss of appetite for more nutritious foods, preventing essential nutrient intake, and increasing the risk of the child becoming overweight and developing caries.

Recommendation from NICE clinical guideline (National Institute for Health and Clinical Excellence, 2008): Limit sugary foods to mealtimes only. Avoid giving biscuits or sweets as treats. Encourage snacks free of salt and added sugar (such as vegetables and fruit) between meals. Avoid adding sugar or honey to weaning (solid) foods.

Recommendation from Ready Steady Baby! guidance booklet (NHS Health Scotland, 2009): To protect your baby's teeth, it is important to choose foods without added sugar, sugar is the main cause of tooth decay, so don't give your baby sugary snacks, especially between meals.

Recommendation from Prevention and management of dental caries in children; Dental Clinical Guidance (SDCEP, 2010): Restrict sugar to no more than four times a day, have sugar-free snacks only, and beware of hidden sugars in foods.

Table 5-12 illustrates the median number of episodes per day when food or drink containing NMES was consumed. This includes at mealtimes, as for this young age group, usually eating small sized portions often, it can to be hard to differentiate meals from snacks. Further analysis of the number of these episodes, excluding NMES derived from the natural extrinsic fruit sugars found in pureed fruit and fresh fruit juice is shown.

	Median no. of NMES episodes per day [Q1, Q3]	p-value[14]	**% participants having over four episodes per day (n)**	**Median no. of NMES episodes per day excluding extrinsic fruit sugars [Q1, Q3]**	p-value[14]	**% participants having over four episodes per day (n)**
Total	3.5 [2.2, 4.3]		47.2 (17)	3.0 [1.3, 4.0]		33.3 (12)
SIMD Q1 & Q2 (most deprived)	4.0 [2.0, 4.3]	0.558	53.8 (7)	3.0 [1.6, 4.0]	0.389	46.2 (6)
SIMD Q3	3.8 [2.9, 4.6]		50 (5)	2.8 [1.6, 4.4]		40 (4)
SIMD Q4 & Q5 (least deprived	3.3 [1.5, 4.2]		38.5 (5)	3.0 [0.45, 3.6]		15.4 (2)
Standard education	4.0 [2.5, 4.6]	0.105	61.1 (11)	3.7 [1.6, 4.1]	0.05	50 (9)
Higher education	3.2 [1.3, 4.1]		33.3 (6)	2.3 [0.2, 3.6]		16.7 (3)
NS-SEC 1 (highest)	3.0 [1.6, 3.9]	0.325	25 (3)	2.3 [0.3, 3.5]	0.321	16.7 (2)
NS-SEC 2	4.0 [2.7, 4.4]		60 (6)	3.5 [1.4, 4.2]		40 (4)
NS-SEC 3 (lowest)	4.0 [2.0, 4.6]		63.7 (7)	3.3 [2.0, 4.0]		45.4 (5)
***long-term unemployed**	2.6 [1.6, 4.0]		33.3 (1)	1.6 [1.3, 4.0]		33.3 (1)

Table 5-12 The relationship between the number of eating/drinking episodes containing NMES during the diary period and SIMD, education achieved by the participant and NS-SEC of the household

[14] Kruskall-Wallis test

Participants living in more deprived areas gave an average of 0.7 more NMES episodes during the diary period than participants in the least deprived areas, with 54% of participants in SIMD Q1 and Q2 exceeding the number of NMES episodes per day compared to 39% of participants living in SIMD Q4 and Q5. When NMES derived from pureed fruit and fruit juice is excluded, 46% of participants residing in SIMD Q1 and Q2 were exceeding the maximum number of episodes of NMES per day recommended, compared to 15% of participants residing in SIMD Q4 and Q5. Of the three participants living with grandparents, one gave a mean of five NMES episodes per day (this participant was classified as long-term unemployed, with a higher education; the grandparent's house was in SIMD Q2) and another had over seven episodes per day (this participant's household was classified as NS-SEC 3, with standard education; the grandparent's house was in SIMD Q1). Both these participants did not have any NMES episodes due to natural fruit sugars and were the highest scoring participants for number of NMES episodes. A stronger relationship between education and number of sugar episodes was observed. Participants who attained a higher education gave 0.8 less episodes containing NMES than those with a standard level of education, and this disparity widened when excluding natural fruit sugars (those with a higher education gave 1.4 less episodes per day compared to those with a standard education). Fifty percent of participants with a standard education gave more than four episodes of NMES (excluding fruit sugars) compared to 17% of those with a higher education. Household economic status (NS-SEC) also showed a difference between those participants classified as NS-SEC 3 (routine and manual occupation households) giving 1.0 more episodes of NMES per day compared to participants classed as NS-SEC 1 (managerial and professional occupations). Forty-five percent of the participants in NS-SEC 3 gave four or more episodes of NMES per day (excluding fruit sugars) compared to 17% of participants in NS-SEC 1.

When examining the most common sources of NMES in the diets recorded with the diaries, table 5-13 shows the prevalence and frequency of appearance of food and drink items according to the different age groups.

	Age (months)	% of children offered	Mean no. of episodes over three days	Range
Biscuits, cakes, pastries	6	70.6 (12)	2.3	0-5
	12	100 (13)	3.5	1-10
	18	100 (6)	2.8	1-6
Confectionery	6	17.6 (3)	1	0-2
	12	61.5 (8)	1.5	0-4
	18	83.3 (5)	2	0-3
Pureed fruit	6	76.5 (3)	2.6	0-7
	12	38.5 (5)	2	0-4
	18	0	0	0
Fresh fruit juice	6	17.6 (3)	2	0-4
	12	38.5 (5)	2.8	0-4
	18	16.7 (1)	1	0-1
Diluting juice	6	29.4 (5)	4.6	0-8
	12	46.2 (6)	5.7	0-19
	18	100 (6)	7.7	0-13
Flavoured yoghurts/ fromage frais	6	29.4 (5)	2.2	0-3
	12	84.6 (11)	3.9	0-7
	18	83.3 (5)	2.8	0-5
Added table sugar	6	5.8 (1)	1	0-1
	12	23.1 (3)	2.3	0-3
	18	33.3 (2)	2	0-2
Jelly	6	11.8 (2)	1.5	0-2
	12	7.7 (1)	1	0-1
	18	16.7 (1)	2	0-2

Table 5-13 The sources of NMES and their distribution amongst the diet diaries

There was an increase in the percentage of children offered foods containing NMES with the increasing age of the child, with the exception of pureed fruit, typically given during the early stages of weaning. The percentage of children offered biscuits, cakes and pastries, confectionery, diluting juice and added table sugar (mostly to breakfast

cereals) increased from six months to 18 months of age, as did the number of times they were offered during the diary period. When comparing the children that were not offered certain items there were some differences observed. Seventy-five percent (n=9) of participants in SIMD Q4 and Q5 offered no diluting juice over the three-day period, compared to 60% (n=6) in SIMD Q3 and 36% (n=4) in SIMD Q1 and Q2. Conversely, 64% (n=7) of participants in SIMD Q1 and Q2 offered no or only one flavoured yoghurt/fromage frais over the three-day period, compared to 60% (n=6) in SIMD Q3 and 25% in SIMD Q4 and Q5.

5.6.6.1 Crisps

Although not a source of NMES and not included when calculating the episodes of NMES per day, crisps have been implicated as a cariogenic food source (Grenby, 1990; Maliderou et al, 2006; Johansson et al, 2010; Masson et al, 2010). Also, crisps are high in salt and fat, and often classified as 'junk food'. Table 5-14 shows the prevalence of crisps in the examined diet diaries, which increases with the age of the child.

	Age (months)	**% of children offered**	**Mean no. of episodes (packets) over three days**	**Range**
Crisps	6	0	0	0
	12	46.2 (6)	1.5	0-3
	18	66.7 (4)	2.3	0-3

Table 5-14 The distribution of crisps amongst the diet diaries

5.6.7 Summary of findings

The median number of eating/drinking episodes per day was seven, which is close to the recommendation for the Infant and Toddler Forum (2010). When comparing age of child, SIMD or education of the interviewed parent, there was very little variation in the number of episodes.

Contrary to recommendations that only milk and water should be given between meals (NICE, 2008; SDCEP, 2010), 36% of children were offered diluting juice or fresh fruit juice at times when not having a snack or meal and this feeding behaviour was associated with lower socio-economic status. Within this study, children were consuming greater amounts of milk than recommended, although it is hard to draw conclusions due to the difficulty in calculating amount of breast milk consumed.

Children living in deprived areas were more likely to be offered only processed foods. Parents with a higher education were more likely to provide solely homemade foods.

Twenty percent of the study population had more than four of more toddler-sized portions of fruit or vegetables per day, with less portions and less variety consumed by children living in deprived areas. Parents with a higher education were more likely to offer more portions a day and more variety. Also, children in households classified with a higher occupation had a greater number of portions and a greater variety of fruit and vegetables.

The most frequent source of NMES given to six-month old babies was pureed fruit. This is a recommended weaning food (Childsmile, 2007; NHS Health Scotland, 2009), and as the child grows older and no longer needs food to be pureed, the natural fruit sugars are no longer considered NMES. Excluding purees, the most frequent source of NMES for all three age groups was biscuits, cakes and pastries, flavoured yoghurts/fromage frais and confectionery. Crisps were also consumed by majority (67%) of children aged 18 months.

When excluding NMES derived from pureed fruit and fruit juice, 33% of children had over four episodes of NMES per day, exceeding recommendations from Childsmile (2007) and SDCEP (2010). Non-adherence was more likely in children living in deprived areas and children living with grandparents. Children of parents with a higher education had less episodes of NMES per day than children of parents with a standard education (2.3 compared to 3.7). Children in households classified with a higher occupation had less episodes of NMES per day than other households.

5.7 Secondary dietary analysis

Dietary data collected in the diaries was analysed using the methods described in section 4.9.3.3. Nutrient data was collected for protein, carbohydrate, fat, and sugar, as well as energy (kcal). Although it is not within the scope of this study to investigate the distribution of these nutrients amongst participants, it is relevant to consider the potential of this dietary assessment tool for use in other nutrition studies.

Figure 5-16 illustrates the distribution of nutrients, and the level of information that can be extracted from the diet diaries using the detailed nutrient analysis. There needs to be a degree of caution in interpreting these results as the nutrients derived from breast milk are not included.

Particularly relevant to this study, the daily energy intake was assessed, as the percentage of total food energy derived by NMES is to be examined (section 5.7.2). As shown in figure 5-16, the distribution of energy intake (kcal/day) is broadly comparable to the estimated average requirements for energy in this age group. As described by the British Nutrition Foundation (2009), the daily requirement for energy ranges from a minimum of 645kcal at six months to a maximum of 1230kcal at one to three years of age. The lower values shown on the dot plot are most likely representing breastfed babies receiving additional energy from breastmilk, which could not be included in the analysis.

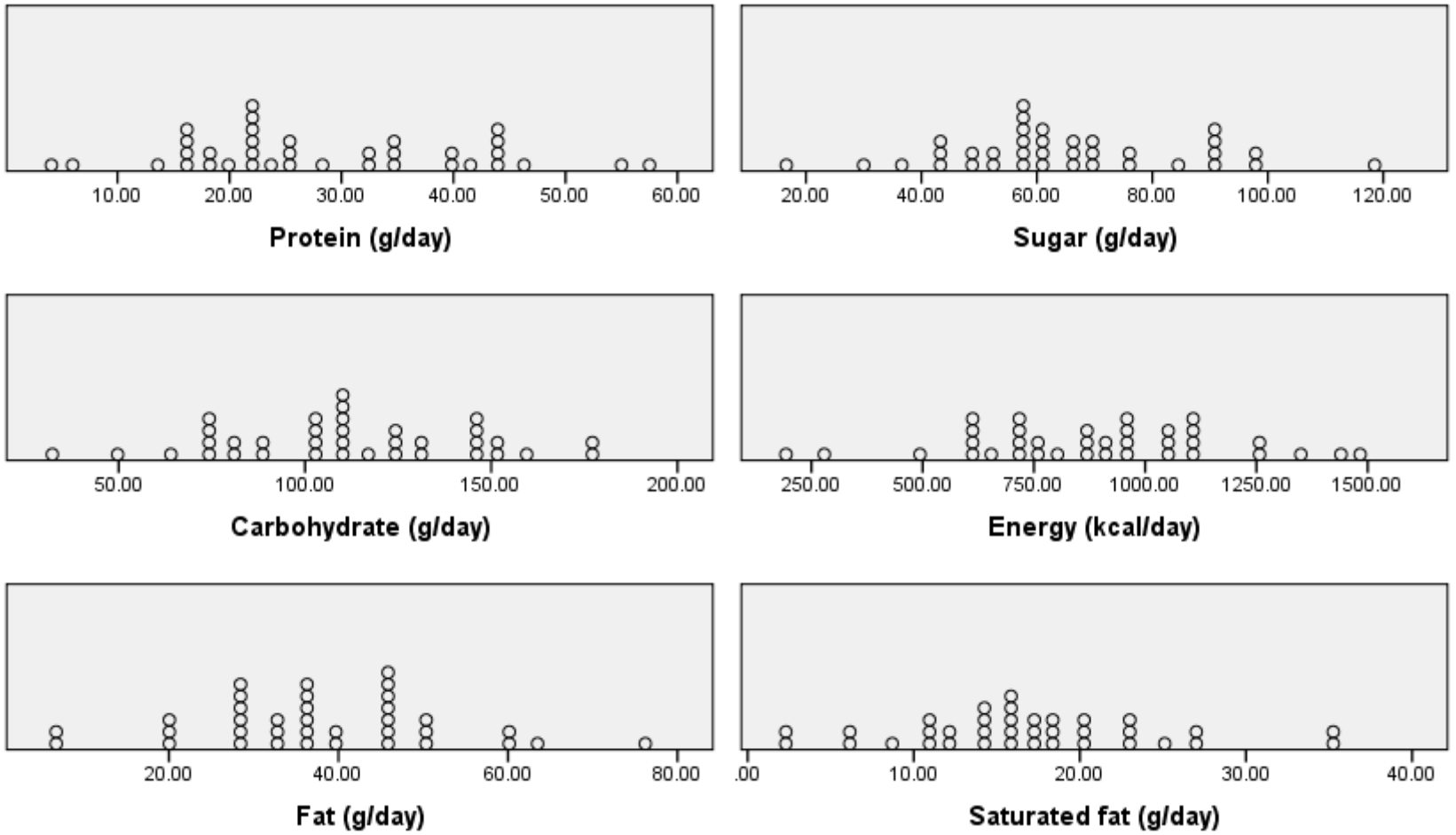

Figure 5-16 Dot plots showing the distribution of nutrient intake showed by the diet diaries

5.7.1 NMES intake (g/day)

Using the WISP database, the individual nutritional constituents of the food and drinks consumed during the diary period could be analysed. Table 5-15 illustrates the quantity of NMES consumed per day, categorised by SIMD quintile, level of education achieved by the participant and NS-SEC of the household, and shows that the overall mean NMES intake (g/day) was 13.4g (SD=9.22) and ranged from 1/3 of a gram to almost 32g per day. There was a trend for increasing NMES consumption with age, with the six-month old age group, having a much lower mean daily consumption of 6.23g (SD=6.31), compared to the 12-month old group with a mean of 19.9g (SD=7.06). Consumption of NMES then appears to remain at this increased amount during the toddler period, with the 18-month old group having a mean daily consumption of 19.5g (SD=4.45). This three-fold increase in consumption in NMES from six months to 12 months contrasted with the very little change in the mean amount of total sugars consumed (for the six-month old group = 63.4g/day (SD=24.3); for the 12-month old group = 68.7g/day (SD=20.7); for the 18-month old group = 58.8g/day (SD=9.12)).

	Amount of NMES consumed (grams/day)			
	Mean	**Std dev.**	**Range**	**p-value[15]**
Total	13.4	9.22	0.33-31.73	
SIMD Q1 & Q2 (most deprived)	14.6	9.65	0.73-29.81	0.849
SIMD Q3	12.6	8.84	0.42-23.57	
SIMD Q4 & Q5 (least deprived)	12.8	9.67	0.33-31.73	
Standard education	14.98	7.70	1.68-29.80	0.302
Higher education	11.76	10.51	0.33-31.73	
NS-SEC 1 (highest)	9.91	9.74	0.42-31.73	0.174
NS-SEC 2	17.38	9.6	0.33-29.81	
NS-SEC 3 (lowest)	13.88	7.82	0.73-24.56	
***long-term unemployed**	11.99	9.47	5.58-22.86	

Table 5-15 The relationship between quantity of NMES consumed per day (g/day) and SIMD, education achieved by the participant and NS-SEC of the household

Table 5-15 shows that children living in SIMD Q1 and Q2 have a slightly greater amount of NMES consumed per day than other children. Children living in a household with extended family consumed the greatest quantity of NMES, with on average 5.2g more

[15] ANOVA

per day that the total average (18.6g compared to 13.4g). Children whose interviewed parent had a standard level of education consumed approximately 22% more NMES per day than children whose interviewed parent had a higher level of educational attainment. Similarly children living in NS-SEC 1 households (managerial and professional occupations) had a mean NMES intake of 9.91g/day compared to children in NS-SEC 2 (intermediate occupations) and NS-SEC 3 (routine and manual occupations) households, who had a mean of 17.38g/day and 13.88g/day respectively.

5.7.2 NMES as % total food energy

Recommendation from the Department of Health (1991): No more than 11% food energy to be derived from NMES.

Table 5-16 shows the percentage of total food energy derived by NMES, and that there is no clear difference due to SIMD, level of education achieved by the participant and NS-SEC of the household.

	Percentage of total food energy derived from NMES (%)			
	Mean	**Std dev.**	**Range**	**p-value[16]**
Total	5.35	3.26	0.20-12.49	0.872
SIMD Q1 & Q2 (most deprived)	5.71	3.20	0.37-10.60	
SIMD Q3	5.31	3.26	0.56-9.44	
SIMD Q4 & Q5 (least deprived)	5.02	3.53	0.20-12.49	
Standard education	5.81	2.56	0.84-10.26	0.403
Higher education	4.89	3.85	0.20-12.49	
NS-SEC 1 (highest)	4.72	3.91	0.37-12.49	0.458
NS-SEC 2	6.53	3.27	0.20-10.26	
NS-SEC 3 (lowest)	5.35	2.77	0.37-8.25	
***long-term unemployed**	3.94	1.60	2.95-5.78	

Table 5-16 The relationship between NMES as % of total food energy and SIMD, education achieved by the participant and NS-SEC of the household

In this study of babies and young toddlers, the percentage of total food energy derived from NMES is on average 5.35%, which is approximately half the maximum

[16] ANOVA

recommended value. Thirty-one percent (30.6%) of children had between eight and 11% of total food energy derived from NMES sources, and so they are in the upper limits of the recommended level.

The proportion of energy derived from NMES increased with age, from the weaning period at six months, to a stable level between 12 and 18 months of age. The six-month old age group had a mean of 3.13% (SD=2.52) total food energy derived from NMES, compared to 7.56% (SD=2.82) at 12 months and 6.82% (SD=1.68) at 18 months. This echoes the trend seen with the amount of NMES as grams consumed per day.

There was no obvious gradient in this value relative to the socio-economic measures of SIMD, NS-SEC and level of education of the interviewed parent. Children living with grandparents as well as parents had the highest percentage of food energy derived from NMES (7.98% compared to a total average of 5.35%).

5.7.3 Summary of findings

The nutritional information obtained from the three-day diet diary developed and used in this study is sufficiently detailed to input into nutrient analysis software (in this case, WISP Version 3) in order to provide full nutrient analysis of intake. This programme can provide information on a range of nutrients as shown in Figure 5-16 as well as mineral and vitamin intake (not shown) for each individual completing a diary. The practicality of this detailed analysis method is discussed further in section 6.4.5.

In this study, NMES intake (g/day) is of relevance. The detailed analysis shows the range of 0.3-31.7g of NMES consumed each day, with a mean intake of 13.4g. There is no relationship between SIMD and the amount of NMES consumed, but children that have more highly educated parents and/or live in a household classified as higher occupation appear to consume less NMES per day. If NMES is considered as a percentage of total food energy, there was no obvious relationship with socio-economic factors. However, children living with grandparents as well as parents had the highest values.

NMES consumption increased with the age of child, from a mean of 6.23g per day at six months to 19.9g at 12 months, with a similar increase in the percentage of total food energy derived from NMES. The mean of 5.4% is well below the recommended maximum of 11% (Department of Health, 1991). However, the increase in the short period after weaning to approximately 7.6% at 12 months and the finding that 31% of participants had between eight and 11% of total food energy derived from NMES shows increasing consumption of NMES with age, towards the recommended maximum value.

Chapter 6- Discussion

6.1 Limitations of the study

6.1.1 Recruitment and size of sample

The Ethics Approval committee stipulated that the recruitment process required potential eligible participants to be contacted by the health visitor in the first instance, for invitation into the study. This could not be done by the primary researcher. The action of telephoning all the recipients of invitation letters required a considerable amount of time, additional to the health visitor's usual workload. Therefore, despite the health visitor's best efforts and commitment to the project, the number of uncontactables may have been lower if the primary researcher had been able to spend time trying phone numbers on repeat occasions at different times of the day, and different days of the week.

The recruitment process, the small population size available for invitation to participate in the study and the pilot nature of the study, prevented large numbers being engaged in the study. Other methods of recruitment were explored, including recruitment at playgroups and health visitor-led baby clinics. However, there were very little eligible participants attending these that had not already been invited by letter. The small sample size means that statistical tests may have low power to detect any statistically significant effects, particularly when analysing subgroups of the participants. However, the study was only ever intended to pilot the dietary assessment tool and examine its practical utility for use in healthcare interventions or studies. The distribution of participants across socio—economic groups was more important than number of participants, in examining whether the diet diary was acceptable for use and completed to a high standard by all groups.

Ethnic minority groups were under-represented in the sample (partly due to the locality of the study). Also, it has to be considered that potential participants with difficulty reading/writing English may have been less likely to participate, due to not understanding the invitation letter and information sheet, and perceived problems with completing the diet diary. Further assessment would be needed to examine the suitability of the diary for use by these groups.

6.1.2 Time of year

The period of participant engagement was from May to September, and this time of year may be associated with more holidays and days away from home, therefore greater difficulty contacting participants, and possibly more refusers, due to these summertime activities.

From another perspective, there is a consideration that diet in the summer may be different than winter months. Although the British climate does not have dramatic seasonal variations, warm summer days may result in higher recording of foods such as ice-cream, ice lollies, jelly and refreshing drinks than a diary completed in the winter.

6.1.3 Diet diaries

As discussed in section 2.9.2.3, as with all dietary assessment tools, there are limitations to diet diaries, which are difficult to overcome. However, it was decided that with the rapid development of an infant's diet over a short period of time, the other methods discussed would not capture accurate detailed information for this age group. Diet diaries rely on the participant to complete independently and may be considered burdensome in some cases, and so the results are only as valid as the participant's ownership and commitment to the research. There is the potential for participants to over-report or under-report dietary behaviour (Stone et al, 2003). With young children, where small quantities are being examined, misreporting could have considerable effect on the nutrient intake calculated. There are potential difficulties with estimating portion sizes/quantities, the amount of food wasted or left over, and having different carers completing the diary (Higgins et al, 2009).

It has to be accepted as a limitation that there may be the potential of participants to report behaviour which is considered socially desirable, particularly in health research studies. This could be either by misreporting behaviour on the diary, or changing to more acceptable behaviours during the diary period. From the feedback comments collected, it may be considered that this may be less likely the case for parents recording the diet of their young children rather than their own diet, as they wish to ensure that they are feeding correctly and receive any advice to aid this.

For the complex nutritional analysis, a senior nutritionist had to make some estimations of ingredient quantity for some home-cooked meals. This was because the participants had given the quantity eaten of the whole meal, rather than individual constituents, which would have been estimation in itself of the amount of each constituent on the

participant's plate. This assumption of the ratio of ingredients within a meal (for example, within spaghetti bolognaise sauce) was deemed acceptable and likely to have very little effect on the results expected. The calculation of nutrients could create under/over-estimation of intake, when quantities were not clearly stated in the diary. Also, it was not possible to estimate the amount of breastmilk consumed, despite recording of the length of feeds, due to individual factors.

6.1.4 Medicines

It is a limitation of the study that the role of regular medicine use on dental health was not explored. Nineteen percent of participants reported giving regular medicines and during the diary period, 14% recorded giving medicine. The quantity of sugar within these medicines and the regularity of their use could be of concern for increasing the risk of early childhood caries. This requires further investigation, which was not explored within this study.

6.2 Recruitment

Thirty-seven parents out of 83 invited, took part in the study. This gave a response rate of 45%. If the 23 uncontactable parents are excluded, the response rate rises to 62%. The older the child, the more difficult it was to contact the parent. Possible explanations for this could be that it was a longer time period from first having their phone number recorded in the case notes, at the time of birth of their child, and so more time to have changed number, or the mother had returned to work after maternity leave, so unable to answer the phone. Those who refused to participate were more likely to have a child of 12 months of age or under. It is unclear whether a different method of recruitment would have engaged more families, or whether those who refused to participate are part of a hard-to-reach group, who are less likely to engage in any health-related research, and may be most in need of targeted support.

In consideration of the use of the diet assessment tool within the Childsmile oral health intervention programme, issues regarding recruitment may not be as important, if the participants are already engaged within the programme via dental health support workers (DHSWs) or a dental practice. As a research methodology to examine the effectiveness of the intervention across the whole socio-economic spectrum, with comparison with a control group potentially required, recruitment rates may be a concern. A larger population of potential eligible participants and a different pathway for recruitment may improve the number of participants.

6.2.1 Socio-demographic profile of participants

Participants were more likely to live a less deprived area than the non-participants invited into the study. However, within the participant group there was an even distribution of the participants across the SIMD quintiles, and 65% lived in SIMD Q1-Q3, so are assumed to require enhanced caries prevention (according to the additional support payment to dental practices) (Scottish Government, 2011b). Participants were as likely to have attained a standard level of education (completing secondary school or sixth-form college) as a higher education (college of further education or university, including postgraduate studies). Also, there was even distribution of the participants' households into socio-economic groups according to the NS-SEC classification, with 32% classed as higher managerial and professional occupations, 27% classed as intermediate occupations and 30% classed as routine and manual occupations (11% were unable to be classified by occupation, due to long-term unemployment).

It has to be considered that the participants are an accessible and motivated group of parents/carers, who are not only more likely to engage with health research, but also with healthcare providers and educators. It is a limitation of this study, as well as other health research studies, to accept that participants of studies are a true representation of the general population, when their participation in itself distinguishes them as a more health aware and interested group. This has implications with the transference of methodologies to healthcare policy, particularly when a key aim of Childsmile is to target and include subgroups of the population that are harder to reach and engage with. Family and life circumstances which make sub-groups of the population hard-to-reach also create barriers for acceptance and compliance of an assessment tool. Engagement of the families most in need of dietary intervention is the main obstacle which limits the usefulness of the diet diary within the Childsmile programme.

6.2.2 Time and cost implications of recruitment

Time spent on recruitment involved both the primary researcher and the health visitor involved in the participant invitation process. Selecting eligible participants and sending out invitation letters was done in four sweeps approximately six weeks apart over six months. For each sweep, it took approximately one hour during working hours with both the researcher and the health visitor present. Follow-up phone calls to the invitation letters were made by the health visitor during her normal working day, as and when she had free time. This took place approximately one week after the invitation letters were sent out, and took up to two weeks for contact (or repeated attempts for contact) with each parent invited. This was required after each sweep and was quite a considerable undertaking for the health visitor, which she kindly did in addition to her normal workload. The contact details were passed onto the primary researcher, who also had eight participants directly contact to take part.

Time spent by the primary researcher to phone participants and arrange first visits took approximately five minutes per participant. These telephone calls cost no more than £15 of standard mobile phone charges. Collection of socio-demographic data of the refusers and uncontactables took eight hours of the researcher’s time, sifting through case notes and inputting data to be used for analysis.

The printing of the letters, information sheets and forms used during the visits to participants, and the envelopes were paid for by the University of Glasgow, and was negligible (no more than £10).

6.3 Socio-economic assessment

Detailed socio-economic information was gathered from participants to assess whether they adequately represented the general population, and also to consider whether for studies of similar scale and locality, SIMD is a suitable measure of socio-economic status. The rural localities of some participants gave reason for concern that SIMD does not accurately demonstrate their socio-economic position. As an area-based measure, SIMD can be limited in describing an individual's or a household's socio-economic status, and so collection of individual socio-economic data was conducted.

The even distribution of participants across the SIMD quintiles allowed examination of socio-economic differences, and of SIMD compared to individual socio-economic factors. It was observed that there was a relationship between SIMD position and number of years of full-time education and level of education achieved by the interviewed parent. It then follows that the more educated participants would be employed in the more skilled, professional occupations, and so a relationship was seen between occupation classification of both the mother and father in the household and SIMD position. Income had a close relationship with SIMD, with those living in more deprived areas more dependent on government benefits to provide the majority of the household income, compared with those living in the least deprived areas, receiving a very little proportion of a more substantial household income from benefits.

Comparison of the individual participant factors of education, employment and income has shown that SIMD adequately represents variations in these socio-economic measures by an amalgamation into a national deprivation index. The close relationship of SIMD with individual socio-economic factors shows that SIMD can be confidently used as a measure of socio-economic position, even with a small sample size of a population with varying urban and rural localities, such as this study. Therefore, SIMD has been used to compare weaning behaviour and the diet diary content of participants. NS-SEC was also used to examine the effect of household occupational status on dietary behaviour. Additionally, the level of educational attainment (standard or higher education) of the interviewed parent (the main food provider) was chosen as a factor to compare the knowledge and practice of dietary recommendations. It was considered to possibly have a greater impact on weaning behaviour than income or employment, and also had the least significant relationship with SIMD. The results showed that for most analysis, comparison of educational attainment of the parent gave the strongest trends with patterns of weaning and dietary behaviour. This may be due to greater numbers within the two groups compared to the three groups of SIMD or NS-SEC. It could suggest that the modifiable factor of education may have a greater effect on feeding behaviour.

6.4 Practical utility of the diet diary

The need for this study came from observations that there is a social gradient in dental caries experience, which exists from a very young age. The influence of dietary behaviour on this relationship may be established from the age of first foods. If intervention was to be aimed at altering the life course of an individual, before poor dietary behaviour became habitualised, there is a need to monitor this intervention to assess outcomes and effect. At present, there is insufficient data to describe current infant nutrition and feeding behaviours following weaning into early childhood in Scotland (Flanagan & Gordon, 2010). Established studies in England (ALSPAC and the National Diet and Nutrition survey) utilise diet diaries to collect this information. This study aimed to examine the practical utility of this methodology to potentially examine the feeding behaviour of children participating in the Childsmile oral health improvement programme. In order to collect dietary information to adequately evaluate NMES consumption and effect change in behaviour (to reduce the risk of caries experience) acceptability of the diet diary, compliance with the procedure and quality of the information recorded needed to be assessed.

6.4.1 Acceptance and completion by participants

A diet diary was developed to allow accurate recording of an infant's diet over three days. Although an informal pilot was conducted during the development of the content and format of the diary, this project was, in essence, a pilot study to assess the practicality and usefulness of such a diet assessment tool. Despite participant numbers being lower than anticipated and preferred, results showed that, of the parents who agreed to take part, approximately 90% completed the diary to a very high standard (of at least 80% completeness). Completeness was assessed using a set of criteria developed for this study, and was based on examination of the diary and discussion with the main participating parent about their views on completing the diary. In some cases, it was not possible to talk to other carers who were involved in completing the diary, and there is a limit to the degree of completion which can be assumed. Potentially, complete snacks or drinks could have been forgotten to be included, and so there is an assumption made that the recording was carried out thoroughly by all people involved. However, in most cases (68%) the diary was only completed by the parent who was involved in the feedback and examination of completeness, and there were no occasions when they felt they had missed recording an eating/drinking episode completely. Also, there was a page in the diary for other carers to state if everything consumed had been recorded, and in all cases, this was answered 'yes'.

This illustrates that completion of this diet assessment tool to a standard that would be of use in determining the dietary behaviour of an infant, is possible by the vast majority of parents engaged in the intervention. Also, acceptability of the diary was very high, as only one participant did not return the diary, with 36 participants completing the diary to some degree (33 to a very high standard). The compliance rate of participants may have been anticipated by their agreement to take part in the study, but the quality of the data recorded using the diary was much greater than expected, and hence led to the extension of the study to analyse the dietary behaviour of this group of infants.

The commitment of the participants to the study was shown by the feedback questions, and the individual ways they collected the data, or involved other carers in the completion of the diary. Multiple carers involved did not affect the quality of data recorded. It was apparent through the informal discussions, that most participants took ownership of the diary and overcame obstacles within their daily routine to allow accurate recording of the infant's feeding behaviour. Consideration that there may be more effort and commitment to the diet diary because of participation in health research rather than as part of the healthcare process seems unnecessary because, as mentioned by most participants, the reason for their participation was in order to help, in a small way, with efforts to improve children's health. If the diary was to be completed as part of a healthcare intervention, the same motivation to improve health would most likely be stronger if specifically for their child.

Due to the high level of compliance and completeness, it is difficult to comment whether these factors differ with the SIMD position of participants. The participant that did not return the diary was living in SIMD Q1, as was the participant that only completed one day before citing family circumstances preventing her continuing the diary period. However, due to the small scale of the study, it is presumptive to draw the conclusion that compliance with the study was less for participants from more deprived areas, considering the other five participants from SIMD Q1 completed the diary to a very high standard (ranked 100% complete).

Due to these discussion points, it is considered that a high standard of completion of the diary is possible by the majority of parents/carers, and this would be similar if the diary was to be used as tool within a healthcare intervention, such as the Childsmile programme. Furthermore, the level of detail gained by the diary allowed a greater depth of dietary analysis than would be necessary for the highlighting of behaviours that increase caries risk. The detail obtained from the study participants (such as quantity of drink consumption, individual ingredients of home-cooked meals, and brands of bought foods) would not be required by families participating in Childsmile. The use of the

diary by parents engaged within the programme, to then be examined by a healthcare professional with them, could highlight potentially damaging behaviours and allow the provision of individually tailored diet advice for their young child.

6.4.2 Time and cost implications of administering the diary

The practicalities of the diary administration involved two visits by the primary researcher to each participant's home. Due to the varying locations of the participants' homes around Dumfries and the surrounding rural areas, most of time incurred by each visit was due to travel, and the cost influenced mainly by petrol consumption. Where possible, visits to participants located in the same areas were timed to reduce travel times and costs. Four participants lived approximately 30 minutes away from the researcher's base, seven lived 20 minutes away and the remaining 26 lived within a 10 minutes drive. With 15-20 minutes spent at the first visit, the length of visits varied from 40 minutes (return travel included) and 90 minutes. Approximately 30.5 hours was spent with first visits, with eighteen of those hours driving. This may be an overestimation, due to linked visits in the same locality, but there were also four missed appointments, which involved wasted travel time. The same length of time driving was required to visit the participants to collect the diaries and gain feedback. Petrol costs were reimbursed by NHS Education for Scotland.

If the diaries had been posted back from the participants, with a self-completed feedback form, the time and cost of administering the diary would be greatly reduced. It is difficult to speculate how this would have affected the completion and rate of compliance, which is why the study design involved collection of the diaries by the researcher. The administration of the diary for research purposes within the Childsmile evaluation programme would depend on the study design and participants involved, and so it is difficult to estimate the time and cost required for such a project.

Although participants were told that if they need any advice or assistance during the diary period, they could contact the researcher by telephone, no parental support was required via this method.

6.4.3 Use of the diary within Childsmile

The home visits were solely used for research purposes. However, if delivery of the diary was incorporated within healthcare provision, such as home visits from health visitors or within Childsmile home visits by DHSWs, there would be very little additional cost to the visit, increasing the length by an estimate of five to 10 minutes. Home visits

are carried out by DHSWs to targeted families with poor attendance at their dental practice, for one-to-one support similar to that given by the researcher. A similar rapport with parents/carers might be expected, as the health professionals will be known by the family.

One purpose of Childsmile Practice appointments is for healthy diet promotion, and this would be a suitable opportunity for implementation of the diary, if risk behaviours were suspected. However, dental attendance may be more irregular and unlikely by the families of lower socio-economic position most in need of the intervention. Provision of the diary within the practice setting would approximately require an additional five to 10 minutes to ask more detailed questions about weaning and give instructions on diary completion. Diary collection would rely on the parent remembering to bring the diary, and may require more additional support by the extended-duty dental nurse (EDDN) to remind parents. Acceptance and completion of the diary may be lower in hard-to-reach sub-groups of the population, and may jeopardise their subsequent engagement with Childsmile. The families most likely to require additional intervention and use of the diary may be seeing the dentist regularly for enhanced prevention and treatment, and so use of the diary by dentists may be more appropriate. However, compliance with use of the diet diary may be poor despite dental attendance.

6.4.4 Quality of information collected from the diaries

The diet diaries could only be considered useful if they allow the collection of sufficient information to accurately describe the typical diet of the subject child. The completeness of the diaries was, as discussed, to a very high standard, and with enough detail to allow dietary analysis. The length of three days was chosen as this was previously used in other established diaries (ALSPAC and the Cambridge Baby Growth Study, as discussed in section 4.3) and was considered of a length that would be acceptable to participants, yet give enough information for the research. Following feedback from participants, it is concluded that four days of diet recording would have been acceptable, especially as many participants felt that once into the routine of filling in the diary, it became straight-forward, and easier with each day. An additional day would have enabled capture of more dietary information and the variety of different days in the week to be recorded. Particularly for the 12 and 18-month old children, who had more variety in the diet, more activity and carers involved in the diary process, four days would have given a broader picture of their feeding behaviour.

Feedback suggested that, although some participants were very enthusiastic to continue the diary for up to a week, other participants would have become over-burdened with

the project. A longer period may have given rise to more drop-outs, less participants engaging in the study from the beginning, and more inaccurate information, with other studies suggesting that the more days of intake a subject records, the less accurate the information becomes (Higgins et al, 2009). For the six-month old babies, most diaries showed that each day had a very similar routine, and so little further information of value would have been gained. Additionally, extra days of diet recording would have given substantially more data to analyse, adding constraints to researcher time.

Traditionally, three-day diaries are designed to include one weekend day, to show variation in dietary behaviour through the week. However, with this young age group, this was considered less important than three consecutive days to demonstrate normal behaviour. However, if use of this tool was to be extended to older age groups, with more participants attending nursery or infant school, it may be appropriate to incorporate this instruction of completing two midweek days and one weekend day in the diary.

With three days of dietary behaviour recording, the diaries were of a high degree of usefulness for both basic analysis by the researcher (and theoretically) health professionals for a general assessment of dietary behaviour, and for complex nutrient analysis by nutritionists.

6.4.5 Time and cost implications of analysing the data

Analysis of the socio-demographic data of the participants, refusers and uncontactables, the introductory diet questionnaire and the primary analysis of the diet diaries was conducted by the researcher over an eight month period as part of a Masters by Research degree. As this was in essence a pilot study to examine the practical utility of the diet diary, there was a considerable amount of new learning involved in the analysis process, with the establishment of spreadsheets, formulation of variables to use, collapsing of groups into appropriate levels, and performing analysis and statistical tests.

To consider the practicalities of the analysis of a completed diet diary with a framework in place, it is estimated that 20-25 minutes per diary would allow time for a trained professional to examine and record the various aspects of completeness described in section 4.9.3.1 (five minutes) and the dietary analysis described in section 4.9.3.2 (15-20 minutes).

Similarly with the detailed dietary analysis, conducted by a Nutrition PhD student, the use of the WISP database was a learning experience for the researcher, and required the development of the programme to contain the nutrient information for processed baby foods (which required obtaining the nutrient information for each product from the manufacturer) as well as homemade meals. Once the database was established, the inputting of data from each diary was estimated to take 30 minutes.

The results of the analysis show, that for the purposes of examining adherence to the recommendations for good dietary behaviour, with respect to dental health, the primary analysis provides detailed information of the risk behaviours recorded within a diary. For individually tailored dietary advice, the detailed nutrient analysis is not necessary.

In practical terms, the diary could be used in a healthcare situation (such as incorporation into Childsmile visits) with the healthcare professional spending approximately 10 minutes to review the diary and compare with guidelines, giving feedback and recommending changes in feeding behaviour. Additional training of EDDNs and DHSWs to interpret a diet diary (using the basic analysis) could be incorporated into the Childsmile training programme and/or continuing professional development courses. Dentists should have existing knowledge from undergraduate teaching to deliver the diary and examine the dietary behaviour recorded.

For use as a research tool to monitor effectiveness, more time would be required to analyse then enter the information into a database, and would take approximately 20 minutes per diary. For quantitative analysis on various nutrients to examine behaviour with respect to other aspects of health (for example protein or energy intake), the detailed analysis may be required.

6.4.6 Technology in diet recording

Technology may have the potential to improve accuracy in dietary assessment studies. The use of gadgetry in the recording of diet has been explored in attempts to attenuate some of the limitations associated with the traditional paper method of completing a diet diary. Higgins et al (2009) validated the use of photography, with participants taking before and after eating photographs of their meals. The results were similar to the paper diaries completed, with no improvement in the accuracy of diet recording, but the method was perceived as more convenient and less burdensome by participants. It was concluded that, for children in particular, where difficulty in knowing ingredients in foods and quantifying portions, the photographic method may be an appropriate

dietary assessment tool. For adolescents, there is greater acceptability in using a mobile computing device than a paper diary (Boushey et al, 2009). There are limitations with the photograph method however, in particular, if forgetting to take a photo, it can not be captured later in the day in the way a diary entry, although not ideally, can (Higgins et al, 2009), and the complex process involved in the analysis (Boushey et al, 2009). For babies and young children, the quantities of intake are so small that the accuracy of photographic recording before and after feeds may be diminished, and with parents/carers recording the diet, the advantages experienced by a study cohort of children will be mostly negated. There is scope for improving portion size estimation, for diet diary recording, with the possibility of use of age-appropriate food photographs as assessment aids (Foster et al, 2009). Further research into potentially feasible technological methods may be appropriate for this young age group of subjects.

From the feedback discussions and focus groups, it was found that the participants in this study did not believe that a computer diet diary would be any easier to complete than a paper diary, and may have greater limitations, such as it would not be as portable, they would not be able to fill it in throughout the day, it would be more time-consuming and less available for their use. It was considered that a traditional paper diary has advantages over more advanced technological methods for use in studies such as this.

6.5 Weaning and feeding behaviour: adherence to health guidelines, with consideration of dental health

6.5.1 Breastfeeding

Mothers are recommended to exclusively breastfeed their infant for six months after birth (WHO, 2001; Scottish Government, 2011a). National data from approximately 90% of births in Scotland in 2009 (collected by the Child Health Surveillance Programme (CHSP), ISD Scotland), shows breastfeeding rates reported by mothers at birth. Sixty percent of mothers were breastfeeding in total (including those using a combination of breastfeeding and formula feeding) and 56% were exclusively breastfeeding (Flanagan & Gordon, 2010). Similarly in this study, 61% of mothers reported initiating breastfeeding.

The CHSP data from 2009 reports that at the six-eight week review with a public health nurse, the total number of mothers reported to be breastfeeding had decreased to 36%, and 27% were exclusively breastfeeding, with minimal change since 2001 (Flanagan & Gordon, 2010). In this study, there was a higher rate of reported continuation of breastfeeding (42% participants continued breastfeeding beyond two months). This may support the earlier comment that this study population may be a more health aware and interested group than the general population, and also more adherent to breastfeeding recommendations. After the six-eight week review, there is no further routinely collected data for Scotland. The Infant Feeding Survey 2005 found that for the UK population, 24% of Scottish mothers were still breastfeeding at six months after birth (Bolling et al, 2007). In this study, 35% of mothers breastfed beyond six months.

Flanagan and Gordon (2011), using data from CHSP, report a relationship between maternal deprivation and breastfeeding. Sixty-seven percent of mothers in the least deprived quintiles in Scotland were breastfeeding at the first-visit review (when the infant is around 10 days old) compared with 30% in the most deprived quintiles (Flanagan & Gordon, 2010). At the six-eight week review, 57% of mothers in the least deprived quintiles were breastfeeding compared with 22% in the most deprived quintiles (Flanagan & Gordon, 2010).This echoes the results of the Infant Feeding Survey 2005 that found babies living in the least deprived areas were almost twice as likely to have been breastfed (77%) than infants in the most deprived areas (44%) (Bolling et al, 2007).

Similarly in this study, there was a significant relationship between the initiation and continuation of breastfeeding with both SIMD and level of education achieved by the mother. There was a considerable difference between mothers not initiating breastfeeding (72% living in SIMD Q1 and Q2 compared to 17% living in SIMD Q4 and Q5).

A similar finding was found when comparing the educational attainment of mothers, as 61% of mothers completing a secondary school or sixth form college education only, did not initiate breastfeeding, compared to 67% of mothers with some form of higher education, continuing breastfeeding beyond two months. Mothers that have higher educational attainment and/or of a higher socio-economic status are more likely to begin and continue breastfeeding up to the age of weaning.

There appears to be socio-economic barriers to breastfeeding, which mirror the findings of other studies into this health inequality, seemingly caused or exacerbated by the perceived cultural norms of different socio-economic groups (Guttman & Zimmerman, 2000; McFadden & Toole, 2006; Dyson et al 2010). The Scottish Government acknowledges the many varied influences on a mother's decision to initiate and continue breastfeeding, and that the health service has a significant role in encouraging and supporting mothers to breastfeed (Scottish Government, 2011a). Attempts to educate mothers of the short and long-term health benefits associated with breastfeeding for mother and child, and the encouragement to initiate breastfeeding should be targeted at the less educated, more socially deprived expectant mothers. There needs to be a change in societal attitudes so that breastfeeding is increasingly accepted as the cultural norm (Scottish Government, 2011a).

6.5.2 Weaning

6.5.2.1 Age of weaning

Across all socio-economic groupings (SIMD, education of parent and household occupation), the most common window to start weaning was between four and six months. Breastfeeding mothers initiated weaning a mean of two weeks later than other mothers. This echoed the findings of Sloan et al (2008), that early weaning (before four months compared to after four months) is related to formula feeding from birth ($p=0.004$) and shorter duration of breastfeeding ($p<0.0001$). Although the recommendation that weaning should not begin before six months of age (WHO, 2001) is the guideline advised in the UK (Department of Health, 2008; Scottish Government, 2011a), within this study the median age of introducing solid foods was 4.75 months, showing that few adhered to this.

In this study, there was a trend seen with timing of introducing foods and socio-economic measures. Children living in more deprived areas, in households with a lower ranking of occupation and/or with less educated interviewed parents, received their first solid foods earlier, and were more likely to have non-recommended first foods.

This concurs with the 2005 Infant Feeding Survey, which reported only 2% of mothers in the UK waited until six months of age before introducing solid foods into the infant's diet and that the main influences on the timing of introduction of foods are socio-economic status, maternal age, educational attainment and prior feeding experiences (Bolling et al, 2007). The survey also found that mothers who started weaning early are more likely to base this decision on the advice of family and friends, whereas mothers who started weaning later were more likely to base their decision on the advice from a professional (Bolling et al, 2007). This suggests there is scope for more targeted professional advice, not only about when to wean but the types of foods recommended as first foods.

As discussed in section 2.6.1, there is some debate about whether earlier weaning may be appropriate and advantageous (European Food Safety Authority, 2009). This may be due to the improved quality of diet available in developed nations, and argues against the WHO's global recommendation, which does not distinguish the different challenges faced by developing nations compared to industrialised countries. Prior to the WHO 2001 guideline, the UK Department of Health (1994) advised weaning to begin between four and six months. The Growing Up Scotland (GUS) cohort study of 5,217 children in 2005/6 (Anderson et al, 2007) found that 80% of infants were weaned during this period (16% of infants received solids before four months, and 4% were started at six months or later). The majority (61%) of parents in this study commenced weaning between four and six months (12% of infants were introduced to solid foods before four months of age, and 27% at six months or later). Research is needed to discover if there has been an increase in the knowledge and acceptance of the change in government recommendations of postponing weaning till around six months since the GUS study, and the influences involved in the decision to begin weaning.

Foote and Marriott (2003) explain how social and cultural norms in the UK seem to dictate weaning practice, rather than the shift in government policy, and advise that emphasis on encouraging more mothers to breast feed, if only for a few weeks, and discouraging the introduction of solid foods till at least four months, would have greater impact on improving infant health than the guideline of exclusive breastfeeding for six months provided by WHO (2001).

6.5.2.2 Introduction of drinks and the use of feeding bottles

From a dental health standpoint, baby feeding bottles (with a teat) are discouraged for prolonged use after one year of age in the recommendations outlined in section 5.5.6. The action of bottle feeding allows the liquid to wash over anterior teeth and restricts

contact of saliva with teeth (Bowen & Lawrence, 2005; Peres et al, 2009), and prolongs exposure due to the slow drip effect of the bottle. This can give rise to early childhood caries, sometimes known as bottle caries (Nainar & Mohummed, 2004). This is often defined as dental caries predominantly seen on the buccal surfaces of the primary maxillary incisors (Ismail & Sohn, 1999). Of the study participants, 71% of the 12-month old group were still using a bottle with a teat, but the majority had also been introduced to trainer cups and other drinking vessels. Of concern, was that 67% of the 18 month old group were still using a bottle with teat, and this is against the recommendations that, by 12 months of age, bottles should be discouraged.

It was a limitation of this study that the diary did not allow the recording of what drinks were being given in bottles. Of most concern in the development of early childhood caries, is the consumption of sweetened drinks from baby feeding bottles. Frequent and prolonged exposure to sugars, often due to a child going to bed with a bottle of sweetened drink, or drinking at will from a bottle during the day, is implicated as a major cause of early childhood caries (Peterson, 2003). Mohan et al (1998) found that children who consumed sweetened drinks in their baby bottles had a four-fold increase in the odds of oral colonisation by the cariogenic bacteria *S. mutans*, than children whose bottles contained milk. This study found that 47% of the six-month old group were already being offered fruit juice and diluting juice, and this increased to 71% of the 12 month old group and 100% of the 18 month old group. Early introduction of these drinks showed a trend with parental education, with mothers with higher educational attainment less likely to give drinks other than milk and water. Additional valuable information could be obtained from the diary with the inclusion of a column to record what drinking vessel is used when giving each drink. This would require a minor alteration to the format of the diary. This pilot study has shown the benefit of this modification to allow individually-tailored advice about recommended feeding practice.

This high prevalence of juice drinking is against the Childsmile recommendations to avoid sweetened drinks (section 5.5.5). Chestnutt et al (2003) interviewed parents of young children, finding that there was poor understanding of the prolonged effect of exposure to sugared drinks in feeding bottles and cups, and many perceived barriers to the giving of water, such as children reject it, it is cruel and a sign of poverty. The Childsmile care manual states that once offered sweetened drinks, it can be difficult to get the child to accept less sweet-tasting drinks (Childsmile, 2007). Chestnutt et al (2003) concluded that there was a need for further promotion of the oral health message that only milk and water are safe for teeth, and although this may need to be targeted to less educated parents of young babies before weaning, the widespread consumption of juice by toddlers suggests this needs to be a universal message to all.

6.5.3 Toothbrushing

The studies described in section 2.4.1. suggest that prevention of early oral colonisation by *S.mutans* needs to be initiated before tooth eruption (Tannkkunnasombut et al, 2009) with importance placed on commencement of daily toothbrushing as soon as teeth begin to erupt and restriction on the frequency of NMES-containing food/drink intake, particularly at bedtime and in the night (Habibian et al, 2002).

It was a positive finding that, of the children with teeth present, all except one were reported to have their teeth brushed daily. However, the recommendations discussed in section 5.4.3 advise that nothing should be given after brushing at night, to prevent dental caries (reduced salivary flow when asleep can increase risk of dental caries). Less than half (41.7%) of the participants that brushed teeth present did not give anything between brushing and bedtime, with a bottle of milk being given by 37.5% and breastmilk by 12.5% of participants. There was no difference on the habits of offering milk at bedtime across the SIMD groups, with non-adherence to recommendations as likely by parents of any socio-economic position.

Whilst there is continued debate over whether prolonged breastfeeding may contribute to early childhood caries (discussed in section 2.4.4), often reported due to breastfeeding at night (Bowen & Lawrence, 2005; Peres et al, 2009), there is little evidence relating to the similar practice of giving a bottle of milk at bedtime, often in order to aid the onset of sleep in the baby. As discussed above, prolonged use of a bottle can increase the risk of early childhood caries, and this may even be the case with milk, which contains natural sugars. More research into this common practice, and up to what age it may be acceptable before having a detrimental health effect, would be valuable to clarify the recommendations for specific age groups.

Whilst the age group of this study suggests that drinks given at bedtime would be milk, the habit of providing a bottle at bed could warn of this behaviour continuing with other drinks as the child grows older. A UK study of a slightly older age group of 284 three-year olds (Eckersley & Blinkhorn, 2001) found that 79% of children were reported to have a drink at bedtime or during the night, every night. For 24% of children living in deprived areas and 19% of children living in non-deprived areas, these were NMES-containing drinks (Eckersley & Blinkhorn, 2001). Echoing the discussion in section 6.5.2.2, the giving of a baby bottle appears to be ongoing beyond the recommended age of 12 months, with disparity between socio-economic groups. Eckersley and Blinkhorn (2001) reported that the bedtime drinks given were provided in a baby bottle by 28% of parents living in deprived areas, compared to 6.5% of parents living in non-deprived

areas ($p<0.001$). The risk of early childhood caries caused or exacerbated by the action of sweetened drinks given in feeding bottles and cups appears to be much higher in children in deprived areas. Eighteen percent of the three-year old children living in deprived areas had received dental treatment (15% had extractions under general anaesthesia) compared to 4.3% (2.2% with GA extractions) of children living in non-deprived areas (Eckersley & Blinkhorn, 2001). Toothbrushing habits could also contribute to this inequality, with 39% of mothers in deprived areas claiming to brush their child's teeth at least twice a day compared to 65% of mothers in non-deprived areas ($p<0.001$) (Eckersley & Blinkhorn, 2001). This is lower than the reported brushing rates in this study. However, the parents of this study were only asked if they brushed daily, rather than twice a day, and it can not be predicted whether parents of this study will continue to brush their child's teeth up to the recommended age of seven years of age, when children develop sufficient manual dexterity to brush themselves with supervision (Scottish Dental Clinical Effectiveness Programme, 2010). With the introduction of Childsmile Core programme across Scotland, supervised toothbrushing in schools and nurseries has been widely promoted, with facilitation to establish this activity, provision of materials and implementation of standards (Macpherson, Ball et al, 2010). By the end of the 2008-2009 school year, 95% of all Scottish nursery schools were participating in supervised toothbrushing (Turner et al, 2010). Although brushing twice a day at home is still recommended, brushing at nursery and school allows the beneficial effects of good oral hygiene and exposure to fluoride within the toothpaste to be universal to all children, reducing disadvantage due to the variability of home oral hygiene.

6.6 Dietary behaviour: comparison of data recorded in the diet diaries with guidelines and other studies

6.6.1 NMES intake

NMES is a classification referring to all free sugars other than those naturally present in milk and whole fruit and vegetables (Ruxton et al, 2010). Foods high in NMES are implicated as causative factors in the aetiology of dental caries, obesity and diabetes, as well as other health problems (Cowin et al, 2000; Palmer et al, 2010). There is concern that non-adherence to the recommendation that no more than 11% of food energy should be derived from NMES (Department of Health, 1991) begins at weaning and continues throughout life.

An important aim of the study was to investigate whether high quality data on the quantity and frequency of NMES intake could be collected for a young age group of children. It was deemed that sufficient quality data of dietary habits were collected by the diaries to assess daily intake of NMES-containing food/drinks. Detailed nutritional analysis of the diet diaries confirmed that the quantity of NMES in the diet increases with age, with a three-fold increase in NMES consumption from six months to 12 months of age, but then a seemingly stable period after 12 months to 18 months. This confers that NMES exposure and reliance as a diet constituent begins within the first year of life, and a window of opportunity exists to offer dietary advice before habitual behaviour develops. This echoes the literature, which suggest that early dietary education to mothers of weaning babies is important in promoting a healthy diet throughout childhood (Addessi et al, 2005). This increase in quantity of NMES consumed per day was also observed as an increase in the percentage of food energy derived from NMES between six months and 12 months of age. Only one participant (2.7%) exceeded the recommendation that no more than 11% of food energy is derived from NMES, showing that in this study, the recommendation is largely adhered to in young age groups. There is concern however, that the proportion that NMES contributes to total food energy would increase beyond the participant age groups quickly as the weaning diet is replaced with normal foods, and a reduction in the amount of milk consumed may greatly affect the percentage of energy attributable to NMES. Thirty-one percent of the participants had between eight and 11% of total food energy derived from NMES sources, and so they are in the upper limits of the recommended level, which may mean that with increasing age, they could be at risk of exceeding the recommendation. Ninety percent of all the children participating in the survey of sugar intake among children in Scotland reported a diet which exceeded the recommended NMES intake of no greater than 11% of food energy (Sheehy et al, 2008). This is seen to continue

throughout life as the National Diet and Nutrition Survey 2008/2009 reports that of adults aged 19 to 64 years of age, the mean amount of total food energy derived from NMES is 12.5% (Bates et al, 2010).

Results of the survey of sugar intake among children in Scotland show that children who consume a greater amount of NMES per day (reporting consumption of greater amounts of soft drinks, biscuits, cakes and confectionery) are more likely to report treatment for dental decay (Sheehy et al, 2008). In this study, the main sources of NMES appeared to be from biscuits, cakes and pastries, diluting juice and flavoured yoghurts/fromage frais. Eighty-six percent of participants were offered biscuits, cakes and pastries during the diary period, 44% were offered confectionery, and 47% were offered diluting juice, and 58% were offered flavoured yoghurts/fromage frais. The percentage of participants offered these items increased from six months to 18 months of age. The GUS longitudinal study showed further increase in consumption of confectionery with age, as more than 43% of children aged 22 months had sweets or chocolate at least once a day, and 78% consumed these food types at least twice a week (Bradshaw et al, 2008). Although none of the participants in this study reported soft drink consumption, the GUS study reported 12% of children aged 22 months had non-diet soft drinks at least once a day (Bradshaw et al, 2008), which suggests exposure to these drinks may happen in early childhood just beyond the ages investigated in this study.

Consumption of diluting juice was twice as prevalent in deprived areas (62% of participants in SIMD Q1 and Q2, compared to 31% in SIMD Q4 and Q5) whereas more flavoured yoghurt/fromage frais was consumed by participants in less deprived areas (69% of participants in SIMD Q4 and Q5 had two or more portions over the diary period, compared to 38% in SIMD Q1 and Q2). These results show that the sources of NMES in a baby and toddler diet are varied and widespread, but the type of sources offered to the child is influenced by socio-economic factors. The GUS study reported that frequency of consumption of sweets and chocolates is more prevalent amongst the socially disadvantaged groups. Sixty-six percent of children whose mothers had no qualifications ate these foods once a day or more often, in contrast to 37% of children whose mothers had higher grades or above (Bradshaw et al, 2008). Similarly, around double the number of children in households in semi-routine and routine occupations, and in the lowest income group respectively, had sweets or chocolates once a day or more, compared with households in managerial and professional households and those in the highest income group (Bradshaw et al, 2008).

Of particular concern to dental health is the frequency of NMES intake, as discussed in section 2.4.5. The relationship between sugar quantity and dental caries appears to be

weaker than expected (Anderson et al, 2009; Ruxton et al, 2010), and has led to more focus on the importance of the timing and frequency of sugar intake in the aetiology of caries, rather than amount consumed (Harris et al, 2004). The number of eating/drinking events containing NMES per day is of importance in the aetiology of caries. Repeated reduction in the pH of the oral cavity, by the fermentation of dietary carbohydrate by plaque bacteria, causes a net demineralisation of tooth enamel and can lead to dental caries (SIGN, 2000). Frequency of intake of NMES-containing foods and drinks is shown to be significantly associated with dental caries experience in children (Marshall, Eichenberger-Gilmore, Larson et al, 2007; Touger-Decker & Mobley, 2007; Palmer et al, 2010) and in young children, before the clinical signs of caries appear, with colonisation of cariogenic bacteria (Wan et al, 2001; Habibian et al, 2002).

There was no clear association found between the SIMD quintile, education or NS-SEC of participants and the number of NMES episodes recorded per day of diary completion. When NMES derived from pureed fruit and fruit juice was excluded, 46% of participants residing in SIMD Q1 and Q2 gave more than four episodes of NMES per day, compared to 15% of participants residing in SIMD Q4 and Q5. Also 50% of participants with a standard education gave more than four episodes of NMES (excluding fruit sugars) compared to 17% of those with a higher education. It was concerning that the children having the most episodes of sugar intake per day were living with both their parents and grandparents. The GUS study also highlighted the particularly important role of grandparents (38% of parents who mentioned difficulties in controlling the amount of sweets and sugary snacks given to their child, cited grandparents as giving their child these foods). This role depends on the level of involvement they have and may arise from generational differences in attitudes to healthy eating, giving a potential focus for intervention measures (Bradshaw et al, 2008).

When examining the proportion of total number of eating/drinking episodes during the diary period that comprised of or included NMES-containing foods/drinks, it was found that this figure increases with the age of the child. The mean frequency of consumption of NMES-containing foods/drinks accounted for 31, 58 and 65% of the mean total eating/drinking episodes at six, 12 and 18 months respectively. These findings are slightly lower than but support the results of the comparable study discussed in section 2.6.3.2 which found NMES-containing foods/drinks accounted for 46, 60 and 67% of total eating/drinking events for six, 12 and 18-month old children (Habibian et al, 2002). This trend confers a risk of further increase in the daily frequency of consumption of NMES with age throughout childhood, which puts children at greater risk of developing dental caries (due to NMES intake) with age.

6.6.2 Other indicators of diet quality

6.6.2.1 Amount of milk

The recommended amount of milk required by infants and toddlers was compared to the mean daily amount of milk given. Excluding breast milk, the six-month old age group exceeded the recommendation from the Childsmile care manual (section 5.6.3) by almost 50%, but the 12 and 18-month old groups were similar to the recommended amount. A concern with the variation in quantities given could be accounted for by different weights of babies and different appetites, but also by the amount of other drinks offered. In terms of dental health, milk is recommended as a safe drink to give compared to diluting juice or fresh fruit juice, however, large volumes of milk will reduce a toddler's appetite for foods with higher iron content (Infant and Toddler Forum, 2010).

6.6.2.2 Processed versus homemade foods

The Scottish Government (2011a) advises parents to use home prepared foods (without salt or sugar added) rather than commercially made baby foods. Processed foods can be found to have higher fat, sugar and salt content than homemade foods (Infant and Toddler Forum, 2011), and can account for up to three-quarters of sodium in the diet (Cribb et al, 2011). Salt intake in infants is often higher than recommended levels, which can lead to the acquisition of a preference for salty foods and short and long-term health problems, such kidney problems and high blood pressure (Cribb et al, 2011). Processed foods can also prevent the learning of food textures and individual tastes, and the development of acceptability of different food types, whereas homemade foods enable the infant to grow accustomed to eating family foods (Scottish Government, 2011a). A positive finding of the diary analysis was that 83% of parents offered some home-cooked foods to their child. There were some variations when comparing the socio-economic factors. Thirty-three percent of participants living in SIMD Q1 and Q2 were given solely processed foods, compared to 8% living in SIMD Q4 and Q5. Also, 30% of parents who left education after school or sixth-form college gave only homemade foods, compared to 56% of parents with higher educational attainment. These results show that the babies and toddlers living in a more deprived area and/or with a less educated parent are likely to receive more processed foods.

6.6.2.3 Fruit and vegetable intake

Despite the 'five a day' message for the number of portions of fruit and vegetables recommended (Department of Health, 2000; NHS, 2009), 23% of the participants of this

study were offered one or less portions of fruit or vegetables a day during the diary period, and 20% being offered four or more portions. The difficulty in clarifying a toddler-sized portion may lead to some inaccuracy in this data, but it is still of concern that the majority of participants were not reaching the recommended target of intake. The findings of the ALSPAC study, using three-day diet diaries to assess the nutrient intake of infants in 1993 showed more disappointing results. At eight months of age, 34% did not eat any fruit and 25% did not eat any vegetables during the three-day period (Noble et al, 2001). At 18 months of age, 16% did not eat any fruit and 8% did not eat any vegetables during the three days. This data is somewhat outdated, before the five-day message was created. Since then, it has been reported that there are high levels of maternal knowledge of the health messages about the benefits of fruit and vegetables, even in deprived areas of Scotland (Crombie et al, 2008). More recent results, from the second year of GUS longitudinal research project (2006/2007), when the baby cohort was approximately 22 months old, showed that whilst 97% of children ate at least one type of fruit a day, only 25% had four or more (Bradshaw et al, 2008). Only 9% of the children had four or more types of vegetable (not including potatoes) per day, 24% had only one type and 6% had no vegetables in a normal day (Bradshaw et al, 2008). These findings are only a slight improvement on the results of this study, and show that there is little increase in fruit and vegetable consumption after weaning and into childhood, and poor adherence to the recommendations.

A further stipulation of the recommendation is that the five portions are from different types of fruit and vegetables, in order to benefit from the different nutrients found in different foods. Early introduction of a range of foods can lead to acceptance of a broader diet and a daily change to the vegetables offered during the weaning period is advised (Maier et al, 2008). Coulthard et al (2009) reported that the earlier infants were introduced to fruit and vegetables, the more likely they were to eat fruit and vegetables at seven years of age. When looking across all three days of diary completion, 41% of this study's participants were offered five or less different types of fruit or vegetables, which is a discouraging sign of poor acceptance of fruit and vegetables in later childhood.

As discussed in section 2.6.3.1, other studies demonstrate the poor rate of fruit and vegetable consumption in later childhood in Scotland, with only a third of 15-year olds reporting daily consumption of any amount of fruit or vegetables (Currie et al, 2008). Early introduction and acceptance of these healthy foods may be paramount for later consumption, yet the results of this study suggest that the recommendations to offer fruit and vegetables at each mealtime and some snacks (Infant and Toddler Forum, 2010) are often not being followed by parents.

In this study, 33% of participants living in SIMD Q1 and Q2 were offered one or less portions of fruit or vegetables a day during the diary period, compared to 23% of participants living in SIMD Q4 and Q5. Also, only 6% of parents who left education after secondary school or sixth-form college offered four or more portions a day, compared to 35% of parents with a higher education. Similar disparities were seen in the variety of fruit and vegetables offered. There is an inequality in the amount of fruit and vegetables consumed by infants and toddlers, seen when comparing their parent's level of education and to a lesser extent the level of deprivation of the area they live. Similar findings were reported by the GUS study, with 29% of 22-month old children whose mothers had higher grade qualifications or above, ate four or more varieties of fruit per day, compared to 16% of children whose mothers had no qualifications (Bradshaw et al, 2008). Also, 34% of children of households in the highest income group ate four or more types of fruit a day, compared to 18% of children of households in the lowest income group. Vegetable consumption showed the same social patterning (Bradshaw et al, 2008).

This echoes the HBSC report discussed in section 2.6.3.1, that found fruit consumption in 11-year old children in Scotland significantly decreases with increased deprivation (Currie et al, 2008), and suggests that this health inequality begins from the age of weaning, continuing through childhood and into adulthood. Children living in deprived areas or with less educated parents are being disadvantaged, by not receiving the health benefits derived from fruit and vegetable consumption.

6.6.3 Summary

Analysis of the data collected by the diet diaries, by the researcher highlighted foods and patterns of eating associated with higher risk of caries experience, within individual children, in addition to across socio-economic groups. Participating parents considered less deprived (living in a less deprived area classified by SIMD, had a higher level of educational attainment, and/or were in a household with a higher occupation classification) were more likely to adhere to national recommendations for healthy dietary behaviour. They were more likely to breastfeed, to move to free-flowing drinking vessels by 12 months of age, and give only 'safe' drinks of milk and water out with mealtimes. Variations in snacking behaviour and indicators of healthy habits were seen by examination of diary entries. The less deprived participants were more likely to provide homemade meals, and offer greater quantity and variety of fruit and vegetables, as well as less frequent episodes of NMES-containing foods/drinks. However, the more detailed nutritional analysis of the diet diaries revealed less clear trends regarding quantity of NMES intake across socio-economic groups. The relationship

between socio-economic status and dietary behaviour echoes the findings of larger, nationally representative studies as described in section 2.7.3 and 6.6.

Disappointingly, compliance to some recommendations was low amongst all groups, particularly regarding fruit and vegetable, and NMES consumption. As discussed in section 2.7.3.2, lower maternal awareness of specific dietary recommendations is significantly associated with poorer diet, and despite knowledge of general dietary recommendations, adherence to guidelines may be poor (Crombie et al, 2008). In this study, the measure of parental educational attainment showed the greatest disparities in feeding behaviour, compared to SIMD and occupation classification of the household.

Parents have the capacity via their knowledge of nutrition, parenting style, modelling and the food environment to impact on children's emerging food choices, and have a pivotal role in shaping behaviours that are established early in life (Campbell et al, 2008). A key determinant of the nature of an infant's diet is the quality of the mother's diet (Robinson et al, 2007) and guidance to improve children's diet should address the influence and control which mothers exert (Crombie et al, 2008). Family environment impacts on unhealthy eating behaviours, observed by the impact on children's weight (Campbell et al, 2008). As discussed in section 2.7.3.1, mothers living in deprived areas in Scotland do not consider access to shops, availability of healthy food and cooking facilities as barriers to providing healthy foods (Crombie et al, 2008), and the Growing Up in Scotland study found that cost of food has less influence on the feeding behaviour of mothers than knowledge of cooking (Bradshaw et al, 2008). Public health policies need to focus upon the social and economic determinants of food choice by families (Watt et al, 2001). Interventions to promote more positive maternal intentions to the preparation and serving of healthy foods are recommended. Parental attitudes, habits and circumstances can also considerably affect the oral hygiene practices and dental attendance of children, as well as exposure to both fluoride and cariogenic bacteria in childhood. Levin and Currie (2010) report of the positive effect of mealtime routines and parenting style on toothbrushing habits, and suggest that the family and home environment should play a central role in oral health promotion. Determinants of oral health are affected by family, cultural and social norms which are difficult to classify, investigate and attenuate their effects, in order to fully explore the relationship between NMES intake and dental caries experience. Breaking the cycle of passing on inequalities in health through generations requires early intervention (Scottish Government, 2008b) and clear, achievable messages to enhance public knowledge, to improve good dietary habits and oral health (Scottish Executive, 2005).

6.6.4 The need for further data

Flanagan and Gordon (2010) report that there needs to be more current and detailed data on infant dietary behaviour in order to assess progress of interventions. The authors acknowledge the time and expense involved with nutrition surveys, but suggest that improvements in the dietary information collected in existing routine administrative, clinical and survey data sources (such as the Scottish Health Survey and the GUS survey) could increase knowledge on nutrient intake. New data to improve knowledge of current dietary behaviour is presently being collected by the National Diet and Nutrition Survey 2008-2011 (MRC Human Nutrition Research), with a larger Scottish sample, and information on feeding practices and nutrition for infants between four and 18 months. The second survey of sugar intake among children in Scotland, conducted in 2010, has yet to publish results. Also, 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. This increase in knowledge will help direct interventions and establish recommendations for healthy behaviour.

Linkage to health records may reduce the need for new data collection, and should be considered (Flanagan & Gordon, 2010). There is scope for examining the potential usefulness of dietary recording during healthcare interventions in the monitoring of current dietary behaviour of a population as well as an individual, and the effectiveness of the intervention in promoting change.

Chapter 7 – Conclusions and recommendations

The social inequalities in dental caries experience appears to exist in children from as young as three years of age (McMahon et al, 2010). Government policy recognises the need to give every child the best start in life (Scottish Government, 2008b) in order to positively affect the life course of individuals, with a multi-disciplinary approach advocated to improve both oral and general health (Scottish Executive, 2005). Healthcare interventions need to target dietary behaviour at a young age, as eating patterns and food preferences that are established during early childhood are likely to be carried on into later life (Scottish Government, 2011a). Additionally, it is advised that caries prevention interventions are implemented from birth, with increased support for those with greater risk of disease (McMahon et al, 2010). This is the approach used in Childsmile, the national oral health improvement programme, to improve oral health of children in Scotland and reduce inequalities (Macpherson, Ball et al, 2010). One of the key aims of Childsmile is to reduce sugar in the diet; however, to date, little has been done to evaluate the dietary advice component of Childsmile in terms of process and outcome (Turner et al, 2010).

The integration of Childsmile Practice activity into the Statement of Dental Remuneration (SDR) for NHS general dental activity in October 2011 will see an additional capitation payment for undertaking key preventive actions(Scottish Government, 2011b) to reflect the additional work required by NHS dental practitioners and practice team members (such as extended-duty dental nurses (EDDNs)). To support practices to deliver an intensive programme of care for families requiring additional support (anticipated to be the majority of children residing in the most deprived quintiles SIMD Q1-Q3), an additional support payment will be made (Childsmile, 2010). All NHS dental practices are expected to sign this service level agreement, and therefore, dietary advice, alongside other preventive interventions, is to be carried out for all young children registered.

Current Childsmile recommendations for dietary interventions provided for children from one year of age, requiring enhanced prevention (those assessed as having increased caries risk) includes considering the use of diet diaries alongside action planning, and positive, supportive motivation (Childsmile, 2011b). The current practice of dental professionals giving dietary advice is not standardised and has had little research. Moyhihan (2002) reported that when advice is given, it is often ad hoc, with little patient interaction and follow-up, possibly due to financial constraints. However, with financial incentives now introduced, there is the requirement for personal, achievable advice, in order to elicit dietary change through promotion and intervention.

7.1 Conclusions

This study aimed to investigate the practical utility of a three-day diet diary, administered by a dental health professional, to assess the dietary behaviour of infants and toddlers aged six to 18 months, with a view to implementation within Childsmile. Within the programme, there are two potential uses for this dietary assessment tool:

1) to be used by EDDNs or dental health support workers (DHSWs) when delivering dietary advice to parents during Childsmile appointments. The diet diary could be used as a tool for monitoring their child's diet, setting targets for improvement of their diet with the parent, and assessing progress towards these targets over time.

2) to aid in the evaluation of new dietary interventions (compared to current practice), which would be implemented within specific research projects embedded within Childsmile (but not part of the overall programme).

The following conclusions have been made:

Recruitment to the study was limited by the size of the eligible population within Dumfries and Galloway, and constrained by the time afforded by the health visitor in making initial contact for invitation into the study (a condition set by the Research Ethics Committee).

The recruitment rate was low overall (45%) and those living in more deprived areas were less likely to engage with the study. However, 65% of participants lived in SIMD Q1-Q3, and so are assumed to require enhanced caries prevention (according to the additional support payment to dental practices) (Scottish Government, 2011b). It is unclear whether a different method of recruitment or a less onerous method of dietary assessment would have engaged more families, or whether those who refused to participate are part of a hard-to-reach group, who are less likely to engage in any health-related research.

Engagement of the families most in need of dietary intervention is the main obstacle which limits the usefulness of the diet diary within the Childsmile programme. Family and life circumstances which make sub-groups of the population hard-to-reach also create barriers for acceptance and compliance of an assessment tool.

Despite difficulties with initial recruitment, once engaged with the study, compliance was high amongst participants and there was a reasonable spread of social groups and

family circumstances. Compliance may have been influenced by the way the study was conducted: the home visits by the researcher, avoiding reliance on participants travelling to a place to take part; the time spent and the rapport established; the overall approach to the delivery and administration of the diary.

Within the group of engaged and motivated participants, completeness and quality of the data recorded did not appear to be influenced by socio-economic factors (deprivation or education of the parent) or other family circumstances. High compliance was suggested by the feedback received and the quality of information recorded in the diaries (which was to a level sufficient to analyse using WISP).

The diet diary is suitable to deliver to parents/carers during home or dental practice visits (Childsmile visits), by dental professionals giving one-to-one support similar to that given by the researcher. However, dental attendance may be more irregular and unlikely by the families of lower socio-economic status most in need of the intervention. Diary collection would rely on the parent remembering to bring the diary, and may require additional support to remind parents. Acceptance and completion of the diary may be lower in hard-to reach sub-groups of the population, and may jeopardise their subsequent engagement with Childsmile.

The three-day diet diary designed for this study provides a standardised method of collecting detailed information on the dietary behaviour of young children (from weaning age) and can be delivered and administered by a dental health professional after appropriate training.

The diet diary is deemed a more suitable methodology than FFQs for this age group due to the rapid changes in diet and portion size during the weaning period. The user-friendly, professional format of the diary aids the recording of information pertinent to oral health: daily frequency, quantity and sources of NMES intake; consumption of sugared snacks and drinks out with meals; prolonged exposure to sugared snacks or drinks; and foods and drinks given after bedtime (information not gathered by an FFQ). It also provides information on indicators for general health: homemade versus processed foods, amount and variety of fruit and vegetables, crisps and savoury snacks consumption.

The Childsmile training programme for EDDNs and DHSWs includes identification of dietary habits which increase the risk of caries development. Additional training to interpret a diet diary (using the basic analysis) could be incorporated into this training programme and/or continuing professional development courses. Dentists should have

existing knowledge from undergraduate teaching to deliver the diary and examine the dietary behaviour recorded.

Detailed nutritional analysis can also be undertaken using commercially available software (WISP), but the additional information gained does not appear to warrant the considerable time and cost required, for use in dietary intervention. This detailed analysis may be more suited to small research projects with specific hypotheses.

It is expected that this dietary assessment tool could, with slight modifications to the entry examples in the diary to aid completion, be used for children of older age at which caries experience could be clinically assessed.

7.2 Recommendations

This study has investigated the practical utility of a diet diary to assess/monitor the diet of very young children within a large national oral health improvement programme (Childsmile), and makes the following recommendations:

The diet diary piloted within this study is considered suitable, by examination of its practical utility, the quality of data obtained and the acceptance by family members involved in its completion, as a diet assessment tool for use with babies and toddlers. However, the validity of the tool needs to be confirmed with a larger-scale study, as the diary method of dietary assessment is susceptible to problems such as under/over-reporting and accuracy of estimation. It is recommended that further research is completed to investigate accuracy of dietary behaviour recording.

It is not recommended to introduce widespread use of the diary for all Childsmile participants as this would require considerable additional time and resources for EDDNs and DHSWs. However, as suggested by Childsmile and SDCEP guidelines (SDCEP, 2010; Childsmile, 2011b), for particular cases of engaged families requiring enhanced prevention, the tool may have a use within the Childsmile practice or home visits, in order to highlight the need for modifications, direct dietary advice and create action plans to encourage change.

The diet diary would be most useful as an evaluation tool within an appropriately designed research study (such as a randomised controlled trial), embedded within the Childsmile programme, to assess the effectiveness of a new/improved dietary intervention when compared to current practice. It is recommended that an overall

approach to the delivery and administration of the diaries is taken, rather than simply the provision of the diary to participants.

Further work is needed in training dental health professionals in the delivery of dietary advice, and in particular in assessing knowledge, attitudes and beliefs of those professionals involved in Childsmile, with respect to the dietary behaviour of young children.

Continued monitoring of Scottish children's diet linked to oral health and socio-economic status within a nationally representative sample is recommended, to evaluate at the national level whether targets are being met with respect to NMES intake and health inequalities.

Further research into the targeted engagement of lower socio-economic groups, most at risk of unhealthy behaviours and development of dental caries needs to be considered, as well as further exploration of the social and economic determinants of the establishment of poor dietary behaviour in early life. Factors implicated in the persistence of socio-economic variation in dental caries experience (such as transmission and oral colonisation of cariogenic bacteria, and parental attitudes and behaviour towards dental health and feeding behaviours) need further research. Then healthcare policies and programmes may be more able to affect change and positively influence the life course of young children at risk of dental caries and other long-term health problems associated with poor diet.

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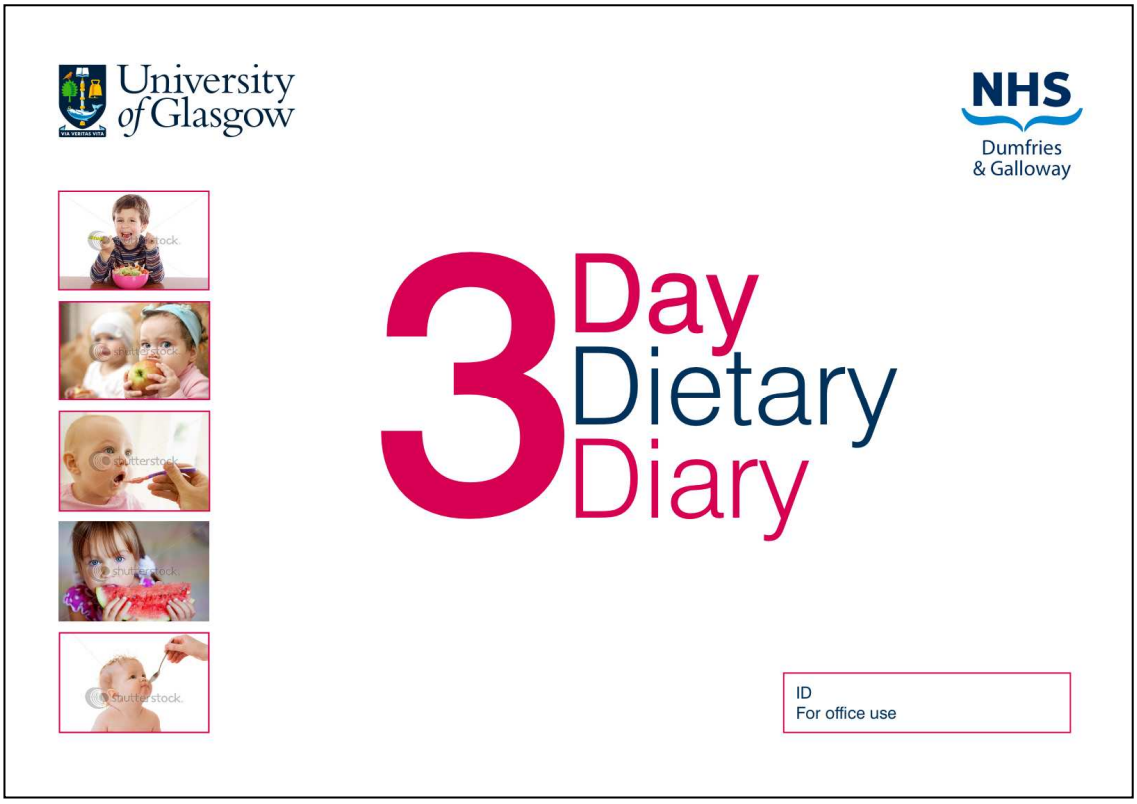
Appendices

Appendix 1- Diet diary

The three-day diet diary (full size A4 landscape): the front cover of the booklet and instruction sheet, and the entry pages for day 1. There was an additional page identical to page 1-4 for food entries. The version used for 12 and 18 month old participants did not contain page 1-1 and 1-2, but asked for milk feeds (including breastfeeds) to be recorded on a page identical to page 1-3 for drink entries. The booklet contained identical pages for the three days, but each day's pages were on different coloured paper. The booklet was bound so as to allow easy flipping of the pages to the appropriate section.



As part of our study to improve dental health in children in Scotland, we are interested in finding out what you feed your baby / young child.

For 3 days we would like you to write down everything that your baby eats and drinks and any medicine they may be given.

We would like you to fill in the diary on 3 days.

The days do not need to follow each other. Please try to fill in all the days but if you cant don't worry.

Just fill in what you can.

Try to fill in what your baby/child eats and drinks as you go through the day, this will help you to remember.

We have given some meal headings as examples to help you.

For each page you need to do just 4 things…

1. **Please write down the day and date that you are filling the diary page for.**
2. **Then what time your child eats or drinks something**
3. **Please write down everything your child has had to eat and drink**
4. **After each meal, please write down anything that was left over.**

Day 1

Day & date:

If your baby has a MILK FEED in a bottle or cup at any time during this 24 hours, please fill in this section.

Time	Amount of milk offered	Amount of milk left
11 (am) / pm	100 ml	10 ml
am / pm	ml	ml
am / pm	ml	ml
am / pm	ml	ml
am / pm	ml	ml
am / pm	ml	ml
am / pm	ml	ml
am / pm	ml	ml

Day 1

Day & date:

If you BREAST FEED your baby at any time during this 24 hours, please fill in this section.

Time	Number of minutes feed lasted	Breast milk given in bottle or cup (Y/N)
3pm	7 mins	No

Day 1 - 2

Day 1

Day & date:

If your baby has anything else to drink in this 24 hours, please record them here. Include water, fruit juice, squash, tea, coke.

Time am/pm	Brand and full description	Did you dilute with water?	Did you add sugar	Amount offered	Amount left	Did this drink last for more than 30 minutes?
3.00 pm	Fruit Shoot Pineapple flavoured drink	Yes	No	50ml	20ml	no
6.30 pm	Asda value Fresh Orange Juice.	No	1 teasp	100 ml	none	no

Day 1 - 3

Day 1

Day & date:

Please record here any foods your baby has in this 24 hours. Include everything he/she eats.
Don't forget sweets, chocolates, biscuits, crisps, fruit,etc.

Type of food				
Time am/ pm	Give full description including BRAND, FLAVOUR, LIQUID ADDED AND FOODS IF HOMEMADE	Amount offered	Amount left	Did this food last more than 30 minutes?
8.00 am	*½ Weetabix mixed with 3 tablespoons whole milk and 1 teaspoon sugar.*	*all*	*Little on face and hands*	*no*
12.30 pm	*Toddler jar, cow and gate, 6mths age: lamb and veg casserole. 200ml.* *White chocolate, cadburys, 50g.*	*½* *½*	*None* *None*	*No* *Yes*
6.00 pm	*Boiled egg with pinch of salt.* *1 slice white bread, thinly spread Flora.*	*1* *½ slice*	*½ white left* *None*	*No* *No*

Please check you have told us the type of bread, type of butter, margarine or spread, any milk and all details of home cooked food

Day 1

Day & date:

Please record the parts of this 24 hours when your baby was looked after by someone else

With whom?	Start time	Return time	All food and drink recorded?
Gran	*10 am*	*3pm*	*Yes*

As far as you know was all the food taken by your child during this 24 hours recorded ?

Yes ☐ Not sure ☐ No ☐

Was the food and drink for this 24 hours fairly typical of your child ? Yes ☐ No ☐

Appendix 2- Invitation letter

Dear Parent/Carer of ……...

I am inviting you to take part in an interesting study being carried out by NHS Dumfries and Galloway with the University of Glasgow. It involves finding a way to collect information about the diet of young children in Scotland, and your help will shape the way health and diet advice is given to parents/carers in the future. National programmes to improve the health of young children need a way of ensuring they are working, and this study will help these programmes best give out information to parents/carers and improve the health of young children.
The information sheet provides more detail about the study and your part in it if you choose to take part.

Our researcher, Mary Wilson, is looking forward to hearing from you if you are happy to join the study. If you would wish to take part or would like more information, please feel free to contact Mary, either by email or telephone/text, leaving your name and number, with your message.

If Mary has not heard from you, I will be giving you a phone call in the next 10 days to see if you are happy to join the study. If you do not wish to take part, you will not be contacted again about the study after this phone call.

Kind regards

Health Visitor
NHS Dumfries and Galloway

Mary Wilson
Text or Phone: 0784XXXXX
Email: maryk.wilson@nhs.net
Address: Lochside clinic, Shirley Road, Dumfries, DG2 0ED

Alternative contact: Supervisor of research
Dr Andrea Sherriff
Phone: 0141XXXXX
Email: a.sherriff@dental.gla.ac.uk

Appendix 3- Study information sheet

Parent/Carer information leaflet

WHY HAVE YOU BEEN CHOSEN?
Your local Health Visitor has written to you to invite you to take part in our study. You have been invited to take part in our study because you have a young child between the age of 6 months and 18 months.

WHAT IS THE PURPOSE OF THIS STUDY?
The purpose of this study is to find the best way to collect information about the eating habits of very young children living in Scotland.

We are also interested in how family or social circumstances might affect how this information is collected in a group of families, so we will be asking questions on your family circumstances, education, job and income.

We ask these questions because they are very important for our study and we would like to assure you that this information will be kept completely confidential.

DO YOU HAVE TO TAKE PART?
It is up to you to decide whether or not you should take part in this study.

If you decide to take part, you will be given this information sheet and a consent form to sign and keep. You will have an opportunity to ask questions at any time.

If you choose not to take part in the study, your child will not be disadvantaged in any way. You can withdraw from the study at any time.

WHAT DO YOU HAVE TO DO? WHAT ARE THE RISKS?
We will ask you to keep a diary of what your child eats and drinks for 3 days (the days do not have to be one after the other). You can contact us (by phone, text, email) at any time for help in filling in your diary. Once you have filled in the diary we would like to ask you how you got on with it, and if there is a better way of giving us this information. You may also be asked if you wish to join a small group to discuss what you thought of the diary. It is not necessary to join a group discussion after completing the diary if you do not wish, but it would be useful to hear your views.

There are no risks involved with completing the diary as you are simply filling in what your child eats and drinks as normal.

WHAT ARE THE BENEFITS OF TAKING PART?
There are no direct benefits of taking part in this study.

However your help with this study may help us to collect important information on what young children eat and drink, which might benefit children in the future.

HOW WILL MY CONFIDENTIALITY BE PROTECTED?
Special precautions are taken to ensure the research study is carried out with a high degree of confidentiality. If you agree to participate in the study, a number specific to your child will be used to identify all results that are recorded at the University of Glasgow. This coding of all information is to ensure that the results are kept confidential by keeping your child's identity and the results separate. Only the researcher will have access to the code key that will connect your study data to you, and is responsible for handling the data in accordance with applicable data protection laws. Please note, the results of the study may be published in medical literature, but your child will not be identified.

CAN I WITHDRAW MY CONSENT?
If you decide to take part in the study, you are free to withdraw at any time. If you choose to withdraw your consent, your child will not be disadvantaged in any way. If you withdraw your consent, any data collected about you or your child will be destroyed.

WHO SHOULD I CONTACT FOR INFORMATION OR HELP?

Primary researcher:
Mary Wilson
Text or Phone: 07842XXXXX
Email: maryk.wilson@nhs.net
Address: Lochside clinic, Shirley Road, Dumfries, DG2 0ED

Alternative contact: Supervisor of research
Dr Andrea Sherriff
Phone: 0141XXXXX
Email: a.sherriff@dental.gla.ac.uk

Independent contact: for general advice about taking part in research
Dr Gwen Baxter
Research and Development Support Unit
Dumfries and Galloway Royal Infirmary
Bankend Road
DG1 4AP
Phone: 01387 XXXXX
Email: gwen.baxter@nhs.net

Thank you very much for taking the time to read this information.

Appendix 4- Consent form

CONSENT FORM-Dietary diary

The Practical Utility of a Dietary Diary for Young Children

SUBJECT ID

1. I confirm that I have parental responsibility for the child above and have read and understood this information. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. I have read and understand the information sheet dated December 2009 for the above study. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐
3. I agree to myself and my child taking part in the above study. ☐
4. I confirm that I have received a signed copy of this information and consent form to keep. ☐
5. I give permission for my child's health information to be used for the monitoring and evaluation of this research study. ☐

_____	_____	_____
Name of Subject's Parent	Signature	Date
_____	_____	_____
Name of Research Team Member	Signature	Date

One copy to be retained by parent and one copy to be retained in study file.

Appendix 5- Parent profile questionnaire

PARENT PROFILE

These questions are about YOU (not your child). We ask these questions because they are very important for our study, but we would assure you that this information will be kept completely confidential.

Child Code (this will be supplied by the research team) _____

1.1 What is your Gender (please tick)**:** Male □ Female □

1.2 How old are you? (please write age in years in box) Age ☐

1.3 Do you smoke? (please tick) Yes □ No □

1.4 How many children do you have? _____

1.5 Ages and genders of children

Age of child	Gender of child

2. Education

2.1 How many years of full time education did you complete? Years ☐

2.2 What is the highest educational level you obtained? (please circle)

1 = Primary school

2 = Secondary school

3 = School or college sixth form

4 = College of Further Education

5 = Polytechnic or University

6 = Some other type of college_____ (specify)

3. Occupation questions

3.1 What is your current / or what was your last occupation? _____

3.1 What is your partner's / spouse's current occupation? _____

4. Income questions

4.1 Would you please look at this table and give the letter for the group in which you would place total household income (including yourself) from all sources, before tax and other deductions.

(write letter in box) ☐

WEEKLY INCOME BEFORE TAX	ANNUAL INCOME BEFORE TAX	
LESS THAN £77	LESS THAN £3,999	A
£78 - £115	£4,000 - £5,900	B
£116 - £154	£6,000 - £7,900	C
£155 - £192	£8,000 - £9,999	D
£193 - £230	£10,000 - £11,999	E
£231 - £289	£12,000 - £14,999	F
£290 - £346	£15,000 - £17,999	G
£347 - £385	£18,000 - £19,000	H
£386 - £442	£20,000 - £22,000	I
£443 - £500	£23,000 - £25,999	J
£501 - £558	£26,000 - £28,999	K
£559 - £615	£29,000 - £31,999	L
£616 - £673	£32,000 - £34,999	M
£674 OR MORE	£35,000 OR MORE	N

4.2 What proportion of your household income (including your own) would you say comes from benefits?

Please tick ONE box

None ☐ very little ☐ about a quarter ☐ about a half ☐ about three quarters ☐ all ☐

Appendix 6- Introductory diet information form

INTRODUCTORY DIET QUESTIONAIRE

1) What sort of bottle or cup does you baby use?
Bottle with teat
plastic trainer cup with lid
plastic cup without lid
glass
carton with straw
cup/mug
other……

2) What type of milk does your baby have as a drink?
Breast milk
Formula: infant, progress, soya, other ……..
Brand of formula ……..
Cow's milk: whole, semi-skimmed, skimmed
Soya
Other ……

NB. clarify which sort of soya: infant or normal.

3) Did you breast feed? If yes:
How old was your baby when you introduced infant formula or other milk?
What age was your baby when you stopped breast feeding?

4) At what age did you introduce a drink other than milk or water to your baby's diet?
What drink was this?

5) At what age did you introduce solid foods to your baby's diet?
At what age did you start giving your baby vegetables?
At what age did you start giving your baby fruit?

6) Does your baby have any regular medicines/ vitamins/ drops?
How often, how much?

7) Does your baby have teeth? Are you brushing their teeth?
Does your child have any food/drink after brushing their teeth at night?

Appendix 7- Focus group schedule

FOCUS GROUP TOPIC SCHEDULE

Firstly I'd like to thank everyone for coming along today. We are really grateful you have given up some of your time for this project.
Our discussion should take no more than 60 minutes of your time at the most but to some extent this will depend on how much you have to say. In order to compare and summarise responses from different discussion groups we'd like your permission to record the session. Only the research team will have access to the transcript and your name will never be put against anything you said. What you say will remain anonymous. I'd also like to ask that for the benefits of our transcribers that we allow one person to speak at a time and try not to talk over each other.
If it ok with everyone, I will take a few notes, just to help me remember later what things we discussed.
Does anyone have any questions? If not, I'd be grateful if you could all sign the consent form.
Ask for first names

GENERAL
What did you think of the diary itself?
What things did you like/didn't like about the diary?
Did they understand what they were to do?
Did they fully understand the instructions?
How easy was it to complete?

CHANGES/IMPROVEMENTS
Were there any things that made it easier to complete the diary?
Were there are things that made it difficult?
How much time did it take up?
How much of a disruption did it cause?
Is there anything about the diary they would change? Format/instructions?
Did anything help with knowing how to fill it in?
How helpful was it to have me talk them through the diary beforehand?
How different would it be if this wasn't the case?
Did they feel supported? What level of support would they like?

ACCURACY OF THE DIARY
Did they find it hard to make the diary as accurate as possible?
Did you feel the diary is an accurate reflection of your child's diet during the three days?
Why/how- prompt fully:
Different carers? Who else? How easy was it for them to fill it in
Abnormal behaviour on those days? Is it difficult to have 'typical' diet days
Difficulty with completion? Not filling in as went along- couldn't remember diet accurately

Were there any specific areas which were difficult (e.g. estimating portion sizes, duration of eating?) Prompt fully
How did they find the recording of milk feeds, the amount, and the length of time?
How easy was it to remember everything? What about drinks, or snacks in between meals?
Was it easy to know the length of time spent eating? Was it hard to judge 30 minutes? Would they have preferred an open ended question asking the length of time rather than yes/no?
How easy was it to know quantities/ingredients? (Specifically about this, may need to use props as in the introductory session) How accurate could you be?

Was there anything that could be changed to help get around these problems?
Or different carers, remembering, quantities

DIFFERENT METHODS OF COLLECTING THE INFORMATION
How acceptable is the diary?
Do they think they could have filled it in as accurately with written instructions?
Did they feel the diary period was the right length to show what normal behaviour was? Too short/long a period?
Do they think doing a diary over three days would give more accurate results than a questionnaire on how often do they feed certain foods, or trying to recall what they gave in the last 24 hours?
What method of collecting this information would be the most accurate?
Would props have helped? Use of texting/ computer package?
How would they feel about a website/ computer programme with questions about diet? Would they be happy to do this? Would they find it easy to do? Would it give an accurate account of their child's diet?

GETTING DIETARY ADVICE
How do they gain information about weaning and what to feed their babies and toddlers?
What advice do they get from other people, from friends and family members?
What advice do they get from health visitors, nursery nurses, other healthcare professionals?

GENERAL CONCLUDING QUESTIONS
What were their motivations for participating?
Do they have any ideas why other people would not be happy participating?
Was the purpose of the study and how the information was going to be used important to them?
Had they thought about who was going to use the information?
If this type of diary was used by other healthcare professionals, would they have been as happy to take part? How would they have acted differently if it was given out with a dental emphasis? Would they have been more reluctant?
Was the diary useful to them? Did it make them more aware of what they were feeding their child?
Do they think the information in the diary will be useful to others?
Did participation in the study have any value to them?
Does anyone have anything else they would like to say? Did anyone have any points they would like to bring up that haven't been covered?

Appendix 8- Focus group consent form

Audio taped discussion about diet diaries:
Information and consent

You are invited to take part in a face-to face discussion where you will be asked your views on the future development of a dietary diary to be used in national programmes to collect information about the diet of young children in Scotland. Information collected by the research team will be strictly confidential and kept in a secure environment in accordance with the Data Protection Act 1998. Your participation is entirely voluntary. You have the right to change your mind about taking part at any time.

Please indicate whether you are willing to take part in an audio taped discussion by ticking the appropriate boxes below.

	Please tick each box you agree with.
I have read the paragraph above and have had the opportunity to ask questions. **I agree** to take part in a discussion about diet diaries.	
I give permission for the discussion to be audio taped.	
I understand that my participation is voluntary and that I am free to withdraw at any time. This will not affect my employment or legal rights.	

_____	_____	_____
Name of Participant	Signature	Date
_____	_____	_____
Name of Research Team Member	Signature	Date

One copy to be retained by parent and one copy to be retained in study file.