UNIVERSITY OF SOUTHAMPTON

The Development of Food-based Nutrition Education and Dietary Assessment Tools for Prepubescent Children

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ABSTRACT

FACULTY OF MEDICINE, HEALTH AND BIOLOGICAL SCIENCES
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THE DEVELOPMENT OF FOOD-BASED DIETARY ASSESSMENT AND NUTRITION EDUCATION TOOLS FOR PREPUBESCENT CHILDREN

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Although it is well recognised that diet is important for health, relatively little is known about the food habits of prepubescent children and the effect of nutrition education programmes in this age group. What is required is a measure of dietary habits which can provide valid information in order to monitor the effectiveness of programmes aimed at improving diet.

This thesis is the first step in developing appropriate dietary assessment methods for use with prepubescent children, focusing on both their knowledge and their behaviour. The tools are for use within the classroom setting, and use food groups as the method of analysis. The project developed and established a food group database which is capable of assessing and monitoring dietary information as supplied by prepubescent children. The food group database produces output in the form of a pie chart showing the proportions of foods consumed within the five food groups as defined by the national dietary guidelines, the Balance of Good Health.

A method for assessing nutritional knowledge has been developed, using draw and write techniques. The method was shown to provide more descriptive detail of foods than a simple list. The method is inexpensive, easy to administer and relatively simple to analyse. Teaching staff could use this method to ascertain areas of misunderstanding or lack of nutritional knowledge.

Two methods for enhancing prepubescent children's nutritional knowledge were developed, based on the national food-based guidelines the Balance of Good Health. The purpose of these tools is to highlight areas of misunderstanding and allowed for more focused nutrition education.

The project has developed methods for assessing current diet in a prepubescent population at the group level. Three methods have been developed, one retrospective and one prospective, using meal and snack-based criteria, and a food type questionnaire looking at usual habits with reference to fat and sugar consumption. These methods can be used to establish baseline dietary behaviour information at the group level, and to monitor changes over time.

The nutrition knowledge and assessment tools have applications, at both the classroom and national level, to monitor the effectiveness of nutrition education and to enhance current nutrition guidelines suitable for prepubescent children. The dietary assessment methods developed within this project can be used to define and monitor food patterns, at the population level.

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Acknowledgements

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Definitions and Abbreviations

BMI	Body Mass Index
BMR	Basal Metabolic Rate
c.i.	confidence interval
COMA	Committee on Medical Aspects of Food Policy
DoH	Department of Health
DLW	Doubly-labelled water
DRV	Dietary Reference Value
FAO	Food and Agriculture Organization
FFQ	Food frequency questionnaire
gms	grams
HEA	Health Education Authority
kg	kilogram
m	metre
max	maximum
med	median
min	minimum
MAFF	Ministry of Agriculture, Fisheries and Food
NSP	non-starch polysaccharides
s.d.	standard deviation
s.e.	standard error
tsp	teaspoon
t stat	Student's *t* statistic
UK	United Kingdom
UNU	United Nations University
US	United States
WHO	World Health Organization

The Development of Food-based Nutrition Education and Dietary Assessment Tools for Prepubescent Children

1 Aims, Objectives and Background

1.1 Aims

1. Develop appropriate methods consistent with the Government's 'Balance of Good Health' food-based dietary guidelines to:

   i) assess nutrition knowledge in prepubescent children

   ii) enhance the guidelines for prepubescent children.

2. Develop appropriate dietary assessment tools for use with prepubescent children in the classroom setting in order to:

   i) assess and monitor food patterns in children at the population level

3. In order to analyse nutritional data from assessment tools, develop a food group database based on the Government's 'Balance of Good Health' dietary guidelines which is capable of:

   i) measuring food consumption patterns

   ii) detecting change in dietary behaviour and nutrition knowledge.

1.2 Objectives

1. Background Information (Chapter 1)

   i) To examine current health and nutrition policies with particular reference to prepubescent children.

   ii) To look at:
   a) the nutritional requirements of prepubescent children
   b) influences on their eating habits and food patterns
   c) influences on their ability to communicate nutrition information.

   iii) To examine current methods of dietary assessment and their possible suitability for use with prepubescent children.

2. Preliminary Studies (Chapter 2)

   i) To identify usual food patterns and eating habits of prepubescent children.

   ii) To identify appropriate methods for prepubescent children to communicate dietary information.

   iii) To examine the capability of prepubescent children to estimate portion sizes

3. Development of a Food Group Database (Chapter 3)

   i) To determine the feasibility of describing nutrition information in terms of food groups.

4. Development of Appropriate Nutrition Knowledge Assessment and Education Tools (chapter 4)

   i) To identify and develop appropriate methods to allow children to communicate their nutritional knowledge.

   ii) To assess the nutritional knowledge of prepubescent children.

   iii) To measure change in knowledge following nutrition education.

   iv) To use the 'Balance of Good Health' guidelines as a basis for enhanced nutrition teaching tools.

5. Development of Appropriate Dietary Assessment Tools (Chapter 5)

   i) To identify and develop appropriate methods to allow children to communicate information on current diet and usual food habits.

   ii) To compare and assess the repeatability of the tools.

1.3 Benefits of this Research

The benefits of classroom-based, nutrition assessment tools are:

1. The provision of dietary information will allow for better targeting of nutrition and health education.

2. Data can be used to monitor changes in knowledge and behaviour following intervention programmes.

3. If the tool is sufficiently accurate at the individual level, it could be used assess and counsel children with specific nutritional problems.

4. The information could be used as part of a cohort study to establish the long-term consequences of sub-optimal food patterns.

5. If the tools are used in the classroom, the information will be easier to collect from prepubescent children, as they are a 'captive audience'.

6. Individual data can be aggregated to give group averages at the class, school year, Local Education Authority or national level, for cross-sectional studies at the same time point or over time.

1.4 Introduction

This thesis is a pilot study to investigate dietary assessment methods for prepubescent children, focusing on both their knowledge and behaviour. Firstly, the thesis establishes a food group database to be used in dietary analysis. Secondly, it develops methods to assess and enhance nutrition knowledge and to measure change in knowledge post-education. Thirdly, the project looks at the development of methods for assessing current diet and monitoring changes over time using food-based analysis.

The association between diet and health is well established, but the consequence of early diet on diseases in later life is not clear. It has been widely recognised that there is a need to assess dietary habits in young people. The Panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy recommended that more investigations be undertaken into the nutrient requirement, nutritional status, and methods for measurement for the UK population, particularly the elderly and children (Department of Health, 1991). The National Forum for Coronary Heart Disease Prevention recommends further research into the nutritional quality of children's diets and food consumption patterns, and the need to track diet through into adulthood (National Forum for Coronary Heart Disease, 1994). In order to do this we need valid and reliable dietary assessment tools appropriate to the developmental stage of the children being assessed.

Currently, there is little information on the effectiveness of nutrition education for prepubescent children. Appropriate valid and reliable assessment tools are the key to providing an evidence-based approach to the evaluation of nutrition education and intervention programmes.

Diet can be measured in terms of its nutrient components, or on the overall balance of foods eaten. The Government has recently issued food-based guidelines with its 'Balance of Good Health' campaign. These guidelines are particularly useful for children, who may have difficulty understanding the concept of nutrients. For this reason this thesis focuses on developing food-based dietary assessment and nutrition education tools. These tools will enable

prepubescent children to understand the elements of their diet and provide them with information to make informed choices about the balance of foods they eat.

Before we can develop tools for prepubescent children, several parameters need to be clarified; these are outlined in the first chapter. We need to be aware of current health and nutrition policies applicable to prepubescent children (section 1.7.1). We need to identify the nutritional requirements of prepubescent children (section 1.7.3.1) and understand what influences their eating patterns and food choices (section 1.7.3.2). It is also important to be aware of the developmental stage of the children and how this may affect their accuracy of reporting (section 1.7.3.3). There are many dietary assessment methods currently in use but we need to know which strategies, if any, are appropriate for use with this age group (section 1.7.4).

Preliminary work conducted for this project included discussion groups with children, parents, teachers and catering staff. This gave a picture of food patterns in this particular socio-economic group of prepubescent children (section 2.2). A direct observational study provided further information on usual eating habits (section 2.3). Children's ability to relate to portion sizes was also conducted as part of the preliminary studies (section 2.4).

The 'Balance of Good Health' guidelines were not intended for use in dietary analysis. However, if dietary advice were being given in terms of food groups, it would be appropriate to determine eating habits in the same manner. Chapter 3 describes the development of a food group database for use with prepubescent children.

Nutrition and health education is seen as a long-term investment to combat the incidence of chronic diseases in later life. Nutrition and health education has recently been introduced into the National Curriculum for all schools (Department for Education, 1995). The Government's mandate states that nutrition and health education forms a key role in sciences for all age groups. It is also implicated in other areas of study. There is currently no mechanism in place to measure the effectiveness of this education policy. There is, therefore, a need for appropriate assessment tools to provide feedback at both local and national levels. The development of valid and reliable nutrition education and monitoring tools is important for both schools and the Government. Chapter 4 investigates

methods of assessing nutrition knowledge in prepubescent children and develops enhanced nutrition education tools in line with the Government's initiatives.

As each of the studies is a discrete entity, details of the methods, results and discussions is given in the relevant section.

Collecting and collating the food-based dietary information at a population level will identify current eating habits and could be used to monitor change. This information will be particularly useful to ascertain the long-term effectiveness of national campaigns on healthy eating. Chapter 5 details the development and comparison of these dietary assessment tools.

The results from this pilot study are unlikely to be generalisable to the UK prepubescent population as a whole. However, if the methods developed during this stage are successful in this select population then the results can be used to inform a larger study. Chapter 6 summarises the results and looks at areas for future research.

1.5 Subjects and Settings

The fieldwork for this pilot project was carried out at a local primary school in the suburbs of Southampton, UK. The school was recommended by the community dieticians and health workers as their curriculum includes a health and nutrition fortnight developed in conjunction with the community health staff.

The children involved in the studies were aged 9 to 10 in school year 5, and of mixed ability and background. School year five was chosen as it is unlikely that any of the children in this year group would have reached puberty. Puberty being defined as the onset of menarche for girls and sperm production in boys (Curtis, 1980). This project is interested in developing nutrition assessment methods for prepubescent children.

The project covered three academic years from 1995/6 through to 1997/8. For ease of identification the children from each school year have been abbreviated as below:

Year 5 Academic year 1995/6 – 'Y5-95'
Year 5 Academic year 1996/7 – 'Y5-96'
Year 5 Academic year 1997/8 – 'Y5-97'

The first year, academic year 1995/6, involved a single class of 31. One further child joined towards the end of the year. The second study year involved 2 classes of year five children. At the beginning of the 1996/7 academic year there were 55 children between the two classes. During the year two children joined the classes and one child left. Finally, the third year involved 57 children from two year 5 classes. One child left and another joined during the year.

Summary of subjects

Academic year	Number of classes	Number of children	Reference
1995/6	1	31*	'Y5-95'
1996/7	2	55†	'Y5-96'
1997/8	2	57‡	'Y5-97'

* one child joined during the year
† two children joined and one child left during the year
‡ one child left and another joined during the year

Table 1: Dataset, section title, section number and year group of children involved in the project (n=number of children in final analysis)

Dataset	Study and section numbers	Year group
Dataset 1	Observation of school lunch (n=25) (Sections 2.3)	'Y5-95'
Dataset 2	Estimation of portion size: *Drawings* (n=24) (Section 2.4.1.1)	'Y5-95'
Dataset 3	Estimation of portion size: *Photographs and Computer Images* (Sections 2.4.1.2 (n=54) and 2.4.1.3 (n=55))	'Y5-96'
Dataset 4	Reference Standard: Weighed Records (n=20) (Sections 3.3, 5.6.2, 5.6.3)	'Y5-96'
Dataset 5	Knowledge of 'Healthy Balanced Meals' (n=31) (Sections 4.2)	'Y5-95'
Dataset 6	Knowledge of 'Healthy Balanced Meals' (n=47) (Section 4.3.1)	'Y5-96'
Dataset 7	Knowledge of 'Healthy Balanced Day' (n=54) (Section 4.3.2)	'Y5-96'
Dataset 8	Food Type Questionnaire (n=50) (Sections 4.4, 5.3)	'Y5-96'
Dataset 9	Measuring 'Balance of Good Health' Knowledge at the Group Level *(Joint exercise carried out academic year 1996/7 when 'Y5-95' were in Year 6)* (n=205) (Section 4.5.1.1)	'Y5-95' and 'Y5-96'
Dataset 10	Measuring 'Balance of Good Health' Knowledge at the Individual Level (n= 42) (Section 4.5.1.2)	'Y5-97'
Dataset 11	Knowledge of Substitute Foods (n=55) (Section 4.5.2)	'Y5-96'
Dataset 12	24-hour Recalls: *Written recalls* (n=27) (Section 5.2.1)	'Y5-95'
Dataset 13	24-hour Recalls: *Written vs. Drawn* (n=48) (Section 5.2.2)	'Y5-97'
Dataset 14	5-day Food Diaries (n=23) (Section 5.4.1)	'Y5-95'
Dataset 15	4-day Food Diaries (n=20) (Sections 5.4.2, 5.6.3)	'Y5-96'
Dataset 16	Reliability of children's records (n=53) (Section 5.5)	'Y5-97'

1.6 Statistical Analysis

This pilot study tests the feasibility of different methods of data collection in a small population of prepubescent children. The statistical methods chosen reflect the small number in the samples.

Statistical methods employed

i) Parametric tests

Parametric tests were used to test the relationship between sets of continuous data.

The Student's paired *t* test has been used to test the difference between two variables measured on the same individual. The null hypothesis assumes that there is no difference between the two variables. For example, for a set of weighed records the actual mean weight of food by food group was compared to the mean weight of food calculated using standardised portion weights. The paired *t* test has also been employed to test the mean of simple portion data with actual data as the portions can be described as quasi-continuous.

The Student's *t* test was used to test the difference between two independent groups of cases. The null hypothesis assumes that the sample variances are equal, that overall population distribution is normal and the means are equal. As the *t* test is a fairly robust measure it was also used to test the quasi-continuous simple portion data.

Pearson's correlation coefficient is a measure of linear association and has been used to measure the relation between two sets of variables.

ii) Non-parametric tests

Non-parametric tests were used to test the association between two sets of discrete data.

The Chi-square tests the goodness-of-fit of categorised variables. It compares the observed frequencies with those that would be expected if the two sets of data had the same proportions in each category.

Spearman's rank correlation has been used to measure the association between two sets of numerical data.

Graphical representations

Piecharts were used to describe the data in a format similar to the 'Balance of Good Health' plate. The majority of the information fed back to the children was in the form of a piechart as this was readily understood by the children.

Boxplots were used to illustrate data which contained a small number of extreme values where the use of the mean and confidence intervals would not have adequately described the data. On the boxplots the extreme values are categorised as 'outliers' where the cases are between 1.5 and 3 box lengths from the lower or upper edge of the box (the box representing the interquartile range) and 'extreme cases' where they are beyond 3 box lengths.

Limitations of the study

The subjects in this project were not randomly selected from the population and therefore the results from these studies are not generalisable to the population as a whole. Sample sizes were restricted to the number of children that the school permitted to be in the exercises. However, this pilot study can be used to calculate sample sizes for further studies.

Information given by the children was frequently compared to information provided by their parents. The parental information was taken as being the "truth". This assumption may be erroneous, but it was not possible to assess the validity of parental information within the bounds of this project.

The results from the studies are intended to be used at a group level and included all children present on the study day. However, the school includes children with special needs who are integrated into the mainstream classes. Where these children could not follow the exercise their contributions were excluded from the analysis. This may limit the use of the tools to children without learning difficulties.

The results of this project will be used to inform further research.

1.7 Background

Objective

1. Background Information

   i) To examine current health and nutrition policies with particular reference to prepubescent children.

   ii) To look at:

      a) the nutritional requirements of prepubescent children

      b) influences on their eating habits and food patterns

      c) influences on their ability to communicate nutrition information.

   iii) To examine current methods of dietary assessment and their possible suitability for use with prepubescent children.

1.7.1 Current Health and Nutrition Policies

1.7.1.1 Nutrition Guidelines

Many of today's health policies in the UK are aimed at reducing the incidence and prevalence of chronic diseases and are based on the assumption that diet influences people's susceptibility to these diseases, (Department of Health, 1994a; Department of Health, 1994b). Currently, the focus for reducing the risks of chronic diseases in the population is on promoting healthy lifestyle, diet and eating habits. For example, the white paper 'The Health of the Nation' (Department of Health, 1992) specifically set out targets for the reduction of total dietary fat. Other targets include reducing obesity, which is identified as a major factor in a number of diseases such as non-insulin dependent diabetes, coronary heart disease and stroke. More recent policy however, has been less prescriptive

referring to the need for "regular physical exercise and eating healthily" (Department of Health, 1998).

Adequate nutrition is defined as "the supply of substrates and co-factors for the maintenance of the structure and function of cells, tissues, organs and the body" (Wiseman, 1995). Adequate nutrition is important in maintaining a balanced nutritional state in a healthy population, but it is the consumption of foods that provides the medium. Historically, dietary advice has focused on the importance of individual nutrients to health, e.g. protein-energy malnutrition, vitamin C for preventing scurvy, vitamin D in preventing rickets and calcium for bones. However, in more recent years there has been a greater emphasis on translating these recommendations into food-based guidelines. Welsh has described food-based guides as a conceptual framework for selecting the kinds and amounts of various food types in order to provide a nutritionally satisfactory diet (Welsh, 1999). The advantage of food-based guidelines is that they are easier for the public to understand and for health educators and meal planners to use.

Translating nutrient based recommendations into a practical food-based guide was one of the targets of the 1994 Nutrition Task Force report 'Eat Well' (Department of Health, 1994c). The report set out an action plan which aimed to achieve the 'Health of the Nation' targets on diet and nutrition. They proposed the development of "a common approach to the presentation to the public of the required balance of foods in the diet by means of a schematic model for a food selection guide". In common with food guides from other countries, a pictorial representation, based on total diet, was chosen as the simplest and most practical way to communicate the message of eating a healthy, balanced diet.

After consultation with health and education professionals, the food industry and the general public, a 'National Food Guide' was produced (Department of Health, 1994c). The aims of the National Food Guide are to:

i) Promote overall health in line with current scientific consensus (Department of Health, 1991) and the 'Health of the Nation' (Department of Health, 1992).

ii) Provide agreed core structure for nutrition education expressed as foods rather than as nutrients in order to minimise or avoid conflicting advice about food for health.

iii) Increase public awareness of appropriate food choices with a view to facilitating the potential for behaviour change.

iv) Focus on total diet (excluding alcohol) consistent with the Government's established guidelines for a healthy diet (Department of Health, 1990):

- Eat a variety of foods
- Eat the right amount to maintain a healthy weight
- Eat plenty of foods rich in starch and fibre
- Do not eat too many fatty or sugary foods
- Preserve vitamins and minerals during storage and cooking
- If alcohol is consumed then keep it to sensible limits
- Above all, enjoy it!

v) Be mindful of current dietary habits, patterns, cultural norms, cost and availability.

vi) Ensure maximum flexibility and enable choice based on food preference and lifestyle.

vii) Be appropriate for healthy people of most age groups. (Not appropriate for infants and children under 5, pregnant and lactating women, frail elderly or those on a medically prescribed therapeutic diet.)

viii) Provide a foundation for the development of educational materials for use in different settings (Gatenby *et al.*, 1995a).

The 'National Food Guide' took the form of the 'The Balance of Good Health' food plate. It has been designed to be used as an education tool to present a consistent, easily understandable message about healthy eating. The food plate aims to achieve an appropriate diet that will supply sufficient nutrients for health, while allowing for differences in social and cultural needs. It highlights the importance of a healthy balanced diet. The emphasis is on eating a varied diet and sensible portion sizes without having to give up any particular foods completely. The recommendations include using lower fat and low sugar products. For example, eating leaner cuts of meat or drinking low-calorie soft drinks. It is intended that the tool be flexible enough to allow it to be adapted for use with many different populations (Gatenby *et al.*, 1995a).

1.7.1.2 The 'Balance of Good Health' Plate

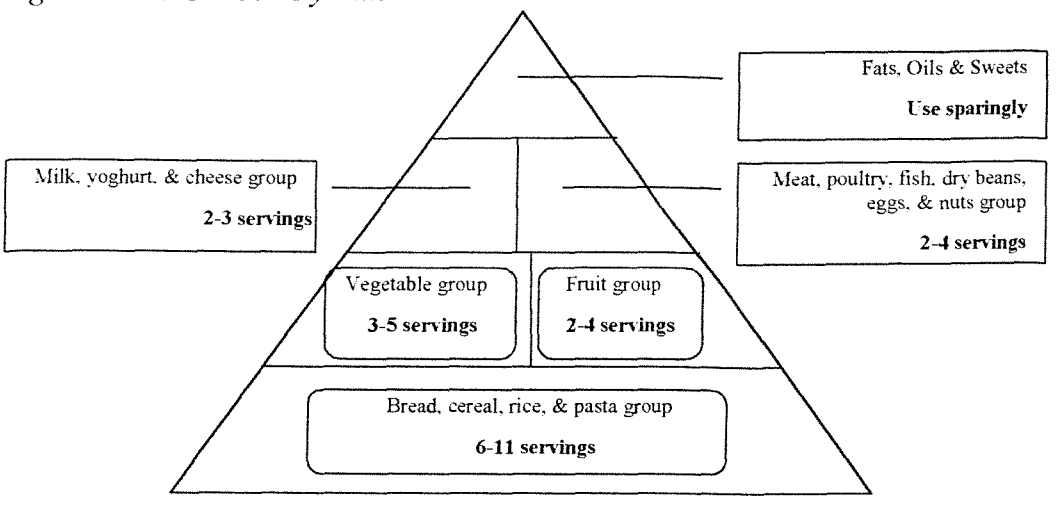
The 'Balance of Good Health' diet is pictorially represented as a plate with examples of each of the food types and is designed to be used as an educational tool (Figure 1).

Figure 1: Balance of Good Health Plate

N.B. The original figure is in colour.

Other countries have produced similar food-based guidelines and have used various visual representations to explain them. Denmark, Germany, Finland and the Netherlands have used a food circle, Canada has used a rainbow, New Zealand, Australia and the United States have adopted a pyramid shape. In some countries the recommendations are more prescriptive than the UK, giving portion size information as well as the food groups. An example of this is the United States food pyramid (US Department of Agriculture, 1993); a schematic representation is shown below (Figure 2).

Figure 2: U.S. Food Pyramid



In developing the plate, the calculation of the proportion of each food group was based on quantitative guidelines consistent with the national Dietary Reference Values (Department of Health, 1991). The underlying dietary modelling was based on the National Food Survey data used for the COMA report on the nutritional aspects of cardiovascular disease (Department of Health, 1994b). Standard portion size data (obtained from the Ministry of Agriculture, Fisheries and Food, and the Office of Population Censuses and Surveys) was calculated as the average amount consumed weekly. Several assumptions were made in deriving the total standard weight of food per food group: miscellaneous foods such as pickles, sauces, tea and alcohol were excluded; the volume of milk and fruit juice was halved as, although they supply essential nutrients, they have a high water content; non-diet soft drinks were included as their sugar equivalent; pulses had been included as a vegetable in the survey data however, as the 'Balance of Good Health' includes pulses as a meat alternative, an arbitrary 0.5% of the total weight of fruit and vegetables was deducted and added to the meat, fish and alternatives group. A comprehensive summary of the calculation is given in a paper by Gatenby *et al.* (1995a).

The 'Balance of Good Health' guidelines recommend that the majority of the diet should consist of bread, cereals, potatoes, fruit and vegetables, with a moderate amount of milk, dairy products, meat, fish and/or vegetarian alternatives, and that the amount of fatty and sugary foods should be restricted. Sugary and fatty foods are not essential to a healthy diet but it is recognised that they add variety and taste. Accompanying advice recommends choosing wholegrain cereal foods to

increase fibre intake, reduce fat consumption by selecting lower fat versions of dairy and other products, choosing leaner cuts of meat, and by reducing the proportion of energy derived from fatty and sugary foods (Gatenby *et al.*, 1995a).

The 'Balance of Good Health' food plate is intended to apply to healthy people of most ages (including children five and over) who do not need to ascribe to a therapeutic diet. The theory is that, if energy requirements are met and the balance within and between the food groups attained, the proportions of foods eaten will be similar regardless of individual energy requirements. Therefore, the 'Balance of Good Health' guidelines should be appropriate for use with healthy prepubescent children.

Currently the recommendations do not include specific portion sizes instead they show the proportion of each food group and some of the types of foods within each group. A publication from the Health Education Authority gave examples of portion sizes for fruit and vegetables as a guide to helping people achieve a target of five or more portions of fruit and vegetables per day (Health Education Authority, 1997). The guidelines emphasise that a balance does not necessarily have to be achieved at each meal but that over the course of a day or two the proportions should be maintained.

Table 2 shows the percentages of foods that the guidelines recommend be eaten from each of the five food groups.

Table 2: Percentage of each food group in 'The Balance of Good Health' guidelines.

Food Group	Percent by weight
Bread, other cereals and potatoes	33
Fruit and vegetables	33
Milk and milk products	15
Meat, fish and alternatives	12
Fatty and sugary foods	7

By following the proportions from the 'Balance of Good Health' guidelines and by ensuring a wide variety of foods within each of the four main food groups, the

Nutrition Task Force estimated that micronutrient and macronutrient targets are likely to be met (Department of Health, 1994c).

The Nutrition Task Force, in its 1996 'Eat Well II' (Department of Health, 1996) report to the Government, recommended that the Department of Health (DoH), the Ministry of Agriculture, Fisheries and Food (MAFF) and the Health Education Authority (HEA) should all raise awareness of the 'Balance of Good Health' by making the model more widely available to the general public. The Task Force proposed that its use by health professionals, educators and the food industry should be reviewed after two years. They further recommended that its value as educational material be appraised and that the degree of general public awareness and understanding of the concepts be assessed. The recommendations for review and evaluation were accepted by Government.

Few food guides have been empirically evaluated for their effectiveness (Hunt *et al.*, 1995). The monitoring of dietary targets set out in the Health of the Nation (Department of Health, 1992) is monitored through the National Food Survey. The latest National Food Survey shows that for the average British diet, 38.8% of food energy comes from total fat, with 15.2% of food energy coming from saturated fats (Ministry of Agriculture Food and Fisheries., 1998). These figures only relate to meals eaten in the home. Confectionery, alcohol, soft drinks and foods eaten outside the home have been excluded. Such foods often contain a higher percentage of fat and/or sugar than those eaten at home. Consequently, the National Food Survey may be an underestimate of the true proportion of fat in the average diet.

1.7.1.3 Nutrition Education and Food Policies in Schools

The Government has recognised the importance of nutrition and health education in schools within the National Curriculum core subjects of science and physical education. Food and nutrition education is part of all four Key Stages of science. The curriculum covers from the basic need for food as a vital part of life through to the more complex aspects of how nutrients work within the body. Core teaching in science Key Stage 2 (ages 7 to 10) ensures that pupils are taught that "food is needed for growth, and an adequate and varied diet is needed to keep healthy". At Key Stage 3 (ages 11 to 14), it is required that "pupils be taught that

balanced diets contain carbohydrates, proteins, fats, minerals, vitamins, fibre and water; the sources of the main food components of the diet; the principles of digestion, including the role of enzymes; that food is used as fuel during respiration to maintain the body's activity and as a raw material for growth and repair" (Department for Education, 1995). This means that prepubescent children are not necessarily taught about nutrients and their relationship to a healthy body and would, therefore, have limited knowledge about nutrient-based dietary advice.

Health education is not part of the core curriculum but schools have a statutory responsibility to provide a broad and varied education in the area of health including food and nutrition. However, as pointed out by Passmore, food, nutrition and health can be incorporated into most of the other core subjects as a cross-curricular theme (Passmore, 1996). A study in the late 1980's of nutrition education in primary schools in Hampshire found that in 96% of schools, headteachers reported that nutrition education was taught (either directly or indirectly) but that in only a third of them a formal nutrition education policy was in place (Cade, 1990).

Nutrition knowledge, in itself, is not sufficient. Knowledge is not necessarily reflected in behaviour. Kelder *et al.* found only a weak positive relationship between knowledge and food choice in a cohort study of children followed from grade 6 through to grade10 (Kelder *et al.*, 1995). Therefore, school health and nutrition policies need to be co-ordinated across all areas to ensure that health and nutrition messages are consistent and do not lead to confusion. Nutrition education should be backed up by appropriate healthy food options available at school; there is little point in providing children with information about healthy eating if the foods available at school do not conform to the healthy food guidelines. Passmore suggests that all school food outlets, such as tuck shops, vending machines and school lunches, need to provide 'healthy' options (Passmore, 1996).

The role of the Government and Local Education Authorities in the provision of healthy and nutritious school meals is less prescriptive than in the past. In 1980, the Department of Education abolished the national standards for school meals which required the Local Education Authorities to provide nutritionally adequate school meals. These standards were replaced by a requirement to provide

adequate facilities for children to eat their own packed lunch and to provide a free school meal to children entitled to one. Many schools go beyond that basic provision but there has been a tendency to have more snack foods available such as pizza, hot dogs, baked potatoes, chips, cakes, biscuits and soft drinks. This allows children to select their own combination of foods with little attention to the balance of foods eaten. Snack foods are intended to supplement foods brought from home but in many cases these actually constitute the child's lunch.

As a consequence of competitive tendering for catering contracts, many schools are run by outside caterers. As a result, individual schools may have little influence over the foods provided. Schools usually retain control over what is sold in tuck shops and vending machines and individual schools need to look at their policies to make sure they are in line with nutrition messages given in the classroom. It has been suggested that 'School Nutrition Action Groups' be set up within individual schools to develop food and nutrition policies (Passmore, 1996). These groups should include representatives from all areas concerned with nutrition education or the provision or consumption of food within the school. They should including a senior staff member (head or deputy), key teachers, pupils and catering staff. They might also include community dieticians, dental health promoters, school nurse, school governors, or parents.

A determination to improve the health of the population and reduce the risk of disease in later life has led the current Government to consider diet in children and the implication of school lunches. They recently issued a consultation paper, 'Ingredients for Success' setting out proposals for nutritional standards of school lunches (Department for Education and Employment, 1998).

The aims of 'Ingredients for Success' are:

i) To help secure, maintain and improve children's and young people's health by improving the nutritional quality of school lunches.

ii) To introduce nutritionally-balanced and enjoyable school lunches based on sensible and workable standards.

iii) To encourage all school lunch providers to supply an efficient and good quality service to their customers.

The Government intends to express the standards in terms of food groups in line with the Balance of Good Health guidelines. They do not intend that caterers have to calculate the nutrient content of the meals they supply, but that they ensure that meals are balanced and provide variety. The expectation is that this will allow menu planners to be more flexible when purchasing and supplying food, and will allow pupils and staff the opportunity to purchase a healthy balanced meal. The Government's intention is that staff with relatively little nutrition training will be able to monitor school lunches using inexpensive aids. At present schools have not been provided the methodology.

It is clear that, in order to monitor school lunches effectively, a simple food-based dietary assessment tool is needed. The tools developed within this research project may be of use in monitoring school lunches.

1.7.2 The Use of Food Groups to Describe Food Patterns

One of the aims of the 'National Food Guide' was to "provide a core structure for nutrition education expressed as foods rather than as nutrients, in order to minimise or avoid conflicting advice about food for health" (Department of Health, 1994c). This philosophy was adopted in the development of the 'Balance of Good Health' plate by the Health Education Authority (Health Education Authority, 1997). More recently, this approach has been used by some of the major UK food retailers in their nutrition advice to customers. Given the increasing use of food-based guidelines in promoting nutrition messages, it would be appropriate to explore whether food groups could be used to measure both nutrition knowledge and actual food patterns.

The use of food groups as a method of dietary assessment for prepubescent children is not a common approach. Musaiger and Gregory looked at food patterns in three age groups (6-10, 11-15, and 16+ years) (Musaiger and Gregory, 1992). Using the notion that each time a food was eaten it counted as a single unit, they showed that there was a notable difference in food patterns between the age groups. In a study of the relationship between food groups and nutrient intake in adults, Kant *et al.* concluded that food groups could be used as a screening tool to identify dietary quality (Kant *et al.*, 1991).

In a study of over 8,000 adults, food intakes were compared with the US food guide pyramid (Cleveland *et al.*, 1997); a complex method for allocating foods to the pyramid food groups was developed. This entailed breaking the food components down to the level of individual ingredients and allocating the individual ingredients to the relevant food groups. The database was extremely complex and required from the subjects, specific details of portion sizes and comprehensive descriptions of combination foods. Prepubescent children do not necessarily know the specific recipe details and are more likely to provide a generic description such as 'meat stew', instead of a beef, mushroom and kidney bean casserole in a red wine sauce. Preliminary studies found that there was wide variation in prepubescent children's estimation of portion sizes.

Food-based assessment tools could allow simple, population-based measures to be established from prepubescence and on through puberty and adolescence, allowing dietary patterns to be monitored throughout this period of rapid growth and development. However, the tools must be simple enough to be used at all ages, inexpensive enough to allow repeated measures to be taken for a large population base and have the degree of accuracy required for the study concerned.

This thesis is concerned with developing assessment methods for prepubescent children. It is intended that the tools should be capable of measuring both knowledge and behaviour in this age group using food groups as the foundation for the analysis. The outcome measures will be population based and provide a broad picture of current dietary patterns and nutrition knowledge among prepubescent children. It is anticipated that the information collected from prepubescent children using the assessment tools will be able to differentiate between high and low consumers by food group. The measures of nutritional knowledge are designed to establish a base and to be able to detect change after nutrition education. Before we can develop the methods best suited to prepubescent children, we must establish a suitable food group database.

1.7.3 Dietary Assessment and Nutrition Education of Prepubescent Children

There are a number of issues which need to be examined with relation to nutrition education and assessment of prepubescent children, including the children's

nutritional requirements, influences on eating habits and food patterns, and their developmental stage.

1.7.3.1 Nutritional Requirements

Metabolic requirements, and therefore nutritional requirements, will vary throughout life. Nutrition education needs to be appropriate for each stage of physical development. During normal adulthood the metabolic requirements of a healthy individual should vary little, but the requirements from conception through fetal stage, infancy, childhood and adolescence will undergo major changes. Children and young people need sufficient energy and a balance of nutrients in order to sustain growth and maintain their levels of activity. Other health concerns regarding children, is to prevent problems such as dental caries, obesity and eating disorders (Garrison *et al.*, 1996; Hill *et al.*, 1994; Morgan and Zabik, 1981).

It has been suggested that current nutritional guidelines may not in fact be appropriate for children (Lifshitz and Tarim, 1996). It is accepted that puberty, along with adolescence, is of particular nutritional importance as the second period of rapid growth in children (the first being from birth to the age of three or four). It is known that nutrition can play an important role in the timing of puberty, with periods of undernutrition resulting in pubertal delay (Bourguignon, 1988). What is not clear is the relationship between eating habits and food patterns during this period and disease in later life. This issue requires further research which in turn demands reliable and valid dietary assessment tools.

1.7.3.2 Influences on Eating Habits and Food Patterns

Puberty is not only a period of great physiological change, it is also a time of rapid psychological and behavioural changes as children begin to gain their independence. One of the manifestations of this independence is an increasing control over what they eat. Although children from a very early age make choices about what they will and will not eat, it is largely under parental control. As a child develops so they take more control over their own diet and parental control diminishes.

There are many factors which influence food choice and eating habits in children, and these factors alter over time. Attitudes about eating are formed from an interaction of cultural, social, family and biological factors. The many competing influences include personal awareness, likes and dislikes, parents, school, peer group pressure, advertising and the media, fast food outlets and social venues (Barr, 1994; Britton, 1995). From puberty onwards, influences outside the home become increasingly important in determining the eating habits and food patterns of children. These influences may affect eating habits and food patterns in a positive or negative manner.

Part of the first steps in growing up and away from family influences is to rebel against the types and amount of foods that are generally consumed in the home. There is also a move away from 'usual' foods towards novel foods, particularly fast foods and snacks, with a greater proportion of children's energy being derived from these sources (Gatenby *et al.*, 1995b; Ruxton *et al.*, 1996a). Nutrition education needs to encourage children to try novel foods but to make them aware of healthy alternatives. As previously discussed (section 1.7.1.3, p.18), this policy needs to be adopted throughout the school by having affordable, healthy options available to the children. Children themselves have limited financial resources and as 'healthier' options frequently cost more, even when children are nutritionally aware they may make poor dietary choices.

In a study of schoolchildren in New York aged 6 to 12 years old, Wolfe and Campbell found that there were significant differences in food patterns and diet quality between age, gender, and socio-economic groups (Wolfe and Campbell, 1993). Older children and children from single parent households were more likely to skip breakfast, boys of all ages were more likely to have a poor food-group pattern, and girls from high socio-economic status families tended to eat more snacks. Children of low socio-economic status and those whose mothers worked full time commonly had less diversity in their diet. These differences may suggest a requirement for more specifically targeted nutrition education for certain groups.

A review of the dietary habits of children and young people in the United States, found as a result of general lifestyle changes, children are now eating more meals prepared outside the home (Kennedy and Goldberg, 1995). The authors reported

that children were eating more frequently than they were two decades ago. There is a notable trend away from the habit of 'three square meals a day' to one of 'grazing'. This means that children are now getting a greater proportion of their overall nutrients from snacks. The review concluded that dietary patterns in children became progressively less healthy with age and suggested that intervention in early school years may have a positive impact. A study of 136 Scottish children aged 7-8 years old found that 26% of their mean energy and nutrient intake came from snacks (Ruxton *et al.*, 1996a). The 1994 Gardner Merchant survey of 11 to 16 year olds, found that children spent, on average, 10% more on snack foods such as sweets, crisps and fizzy drinks on the way to and from school than they did on food bought at school (ANON, 1994). The provision of affordable health foods as snacks has implications for food manufacturers and the retail industry.

Studies have found that the nutrient content of food was not a major concern of young people, and that taste was one of the primary reasons for their choice of foods (Adamson *et al.*, 1996; Dennison and Shepherd, 1995). Oliver and Thelen reported that 9 to 11 year old children who believed their friends would like them better if they were thinner were more likely to have poor eating attitudes and body image (Oliver and Thelen, 1996). These peer influences were particularly strong in girls, although the same trend existed in boys. Various studies of prepubescent and pubescent children have concluded that even young children, particularly girls, show a strong preference for thinness (Hill *et al.*, 1994; Veron-Guidry and Williamson, 1996). Schreiber *et al*, in a study of 9-10 year old girls, found that they were already conscious of body image and that approximately 40% of white girls reported trying to lose weight (Schreiber *et al.*, 1996). It is not only food patterns and eating attitudes that are affected by body size but also the accuracy of dietary recording (Maffeis *et al.*, 1994).

With increasing independence and purchasing power, several factors may influence prepubescent children's eating patterns at this vulnerable time, this is important as it is a time when the formation of eating habits may have a life-long effect. Sweeting *et al.* concluded that eating habits are set, to some extent, while young people are still at school, and may not change dramatically in adulthood (Sweeting *et al.*, 1994). As many dietary habits are well established by

adolescence it is important to begin appropriately targeted nutrition education in younger age groups.

1.7.3.3 Developmental Stage and Capability of Accurate Reporting

In order to develop usable assessment tools, it is important to establish the extent to which prepubescent children are capable of providing accurate and quantitative information. There are three main elements involved in the process; memory, perception, and conceptualisation. Memory will affect the child's ability to recall information. When recalling their own diet, children need to be able to remember the actual foods they ate and if possible the portion size. If assessment tools require detail about portion sizes, then children must have perceptual and conceptual skills. Perceptual skills relate to the ability of the child to assess the portion size of an amount of food actually present, compared to a representation. Conceptual skills refer to the child's ability to identify the portion size when the actual food item is not present (Nelson *et al.*, 1994). If we wish to quantify children's diet, the degree to which they are capable of a) remembering what they ate, b) assessing the amount they ate, and c) expressing this at a later date, is crucial to getting reliable dietary information.

The ability of children to recall, quantify and communicate dietary information largely depends on their cognitive development. Piaget suggested four stages of cognitive development in children, the sensory-motor stage, the pre-operational stage, the concrete operational stage, and the formal operational (Mitchell, 1992). Prepubescent children should be beyond the sensory-motor and pre-operational stages but are unlikely to have reached the fourth stage, formal operational. This may affect their ability to deal with complex dietary assessment tools. Table 3 shows a summary of Piaget's stages of cognitive development (Sylva and Lunt, 1982).

Table 3: Summary of Piaget's stages of cognitive development

Stage	Approx. age	Nature of schemas	Typical adaptations
Sensory-motor	birth to 2 years	practical action	can act intentionally, object permanence
Pre-operational	2 to 6/7 years	symbolic (but not logical)	can symbolise, talk about past and future, judgements showing egocentrism and moral realism
Concrete operational	6/7 to ~11 years	logical and mathematical	can deal with 2+ aspects of a situation at same time, can decentre and conserve
Formal operational	~11+ years	logical and mathematical abstractions	formalism of physics and higher maths, morality based on intentions

(Sylva and Lunt, 1982)

Prepubescent children should have the ability to count and express themselves in a logical manner. They are usually able to determine the intrinsic properties of a food item, for example they can identify that a chicken pie and a beef pie are different and not simply 'pies'. However, children's ability to communicate information may be limited by their language skills. Krauss and Gluckberg found that by the age of ten children were linguistically and grammatically competent but they were not necessarily able to describe items in a way which was understandable to another person (Krauss and Glucksberg, 1969). For example, they may describe a dessert as 'lemon fluff' but do not know the ingredients. This description may not be recognisable to someone unfamiliar with the child.

Using visual aids or getting the children to draw what they eat allows information to be provided without the use of written language. However, young children's drawings tend to be influenced by what they know rather than what they actually see. For example, a child will draw four wheels on a car even if only two are in view (Mitchell, 1992). If this is true for prepubescent children, then it may make it difficult to accurately quantify the proportions of foods consumed.

By the age of seven, the beginning of Piaget's concrete operational stage, children begin to grasp the concept of conservation, for example if water is poured from a tall thin beaker to a short wide one they will recognise that the quantity of water has not changed (Sylva and Lunt, 1982). This means that children from seven

onwards should be able to give quantitative information in a 24-hour dietary recall for example. However, they may find it difficult to translate this data into volumes or mass. The use of food photographs or computer images may make estimation of portion sizes more reliable.

The concrete operational stage of development means that children can understand and deal with real or tangible tasks but are unable to cope with hypothetical or imaginary situations (Mitchell, 1992). This means that children are likely to be able to cope with the question 'what did you have to eat yesterday?' but are unlikely to be able to relate to the question 'what sort of foods do you usually eat and how often?'.

Prepubescent children require more time to perform tasks. Kail found that the relationship between age and speed of visual searching and memory recall was exponential, with prepubescent children taking almost twice as long as adolescents (Kail, 1988). Also, young children have a relatively short attention span and are likely to lose interest in a task unless stimulated.

In conclusion, the development of dietary assessment tools must take into account the cognitive and communication skills of prepubescent children. Any assessment tool developed for use in the classroom will need to allow sufficient time for the children to finish the task.

1.7.4 Dietary Assessment Methods and their Suitability for Children

Before we can begin to determine the eating habits and food patterns of prepubescent children, it is necessary to establish which dietary assessment methods are appropriate. If we wish to demonstrate whether there is an association between dietary intake and the occurrence of a specific disease, we require a tool which will precisely and accurately describe usual diet. Ideally, the assessment would produce an objective, unbiased and qualitative picture of long-term dietary exposure, the rate of absorption and bioavailability at critical times in the development of the disease in question (Kohlmeier, 1995). Unfortunately this is not possible, therefore we have to rely on measures that will give the most accurate estimate of the true diet.

There are several standard dietary assessment methods, mostly validated in adult populations, which may be used to assess food intakes. The main difference between the methods is the period under review, the types of cues used to elicit information, and whether the researcher is mainly concerned with past diet, habitual diet or current dietary patterns. Table 4 below lists the various assessment methods, type of study and the time period for which each method is appropriate.

Table 4: Dietary Assessment Methods

Assessment method	Type of study	Diet assessed	Time period
Diet history	Retrospective	Past diet	often a particular life stage e.g. childhood, pregnancy, etc.
Food frequency questionnaire	Retrospective	Habitual diet	anything from a week to a year
Direct observation	Prospective	Current diet	often only one meal occasionally one day
24 hour recall	Retrospective	Current diet	previous 24 hours
Weighed records	Prospective	Current diet	usually 7 days, rarely more than 28 days
Food diaries	Prospective	Current diet	usually 7 days, rarely more than 28 days
Checklist	Prospective	Current diet	usually 7 days

All the above methods could be used for food-based dietary assessment tools. The following is a review of possible dietary assessment methods which could be used for food-based assessment tools.

1.7.4.1 Diet history

The diet history method was first conceived by Burke for use in developmental studies in children (Burke, 1947). It usually comprises an interview to establish usual food patterns, a food checklist, and a three-day diary. Typically, it involves lengthy and in-depth interviewing of the subject (or knowledgeable surrogate) about his or her usual diet at sometime in the past. This can be in the distant past, as with interviewing adults about foods they ate in their childhood, or in the recent past, for example, last week, last month. Food models, food lists or photographs are often used as prompts. Unfortunately the diet history method relies heavily on

memory and on the ability of the subject to estimate correctly the quantity of food consumed; this is likely to prove particularly difficult for children.

Diet histories are prone to interviewer bias. To avoid this, it is necessary that either the interviews are carried out by the same skilled interviewer, or that interviewers receive training so that they all strictly adhere to the same protocol. Checks must be carried out regularly to ensure this is the case. Interviews that review more than one day generally take between one and two hours to complete. This may become tedious for children since their attention span is limited.

Diet history is not a precise measure of food intake but is an indication of food consumption patterns. Diet histories tend to overestimate food intake, but the average error is likely to be consistent between groups, allowing valid comparisons of group means (Bingham and Nelson, 1991).

A Finnish study of 5, 9 and 13-year-old children, interviewed with a parent, compared the results of a diet history with a 24-hour recall and found that the energy and nutrient values calculated from the diet history were significantly higher than from the 24-hour recall (Rasanen, 1979). They also found that a repeated history interview carried out seven months later gave significantly lower mean values compared to the original information. When they classified the children into thirds for energy, protein and vitamin C only about a half of the children fell into the same third on the second interview. They concluded that the reliability of the diet history method in this age group was low.

A diet history was used to assess the energy intake from the usual diet of children aged 7, 9, 12, 15 and 18 (Livingstone *et al.*, 1990). Children, together with their mothers, reported on their usual weekday and weekend meals and snack patterns (although older children tended to do most of the reporting on their diet). Interviews were carried out in the subject's own home and the variability in the responses depended on many factors including intelligence, motivation, the complexity and variety of the diet, age of the child, and prevailing distractions. Details were also collected on preparation methods, portion sizes, and frequency of consumption. Total energy expenditure (TEE) was calculated and compared to the diet history data. It was found that there was agreement at the group level, but a large variability at the individual level, with a general tendency to overestimate

quantities. Only those aged 18 had consistently lower energy values on the diet history than the calculated TEE, leading to a possible under-reporting bias.

Diet history interviews are expensive in terms of both time and money. From the literature the method would appear to have poor repeatability in this age group. This is likely to be because children change their diet as they become introduced to a greater variety of foods as they grow older. Prepubescent children themselves are unlikely to have the cognitive skills required to complete a diet history. Including a parent in an interview would be costly and, for large-scale studies of prepubescent children, not a viable option.

1.7.4.2 Food frequency questionnaires

Food frequency questionnaires (FFQ's) are based on a predetermined list of foods and are used to assess usual diet over a period of time, e.g. a week, a month or a year. To achieve valid results from the questionnaire it must cover the range of 'usual diets' for the study population. Development of FFQ's often starts with focus group work to establish the list of foods before progressing to pilot studies. The advantages of FFQ's are that they are quick to administer, cheap, and easy to process. Generally, they are not sufficiently accurate to use at the individual level, but may be used to establish a link between diet and disease at the population level.

There are several major disadvantages of using a food frequency questionnaire with prepubescent children. Firstly, children may not identify elements of their diet if certain foods are not specifically included on the list even if they are implied in a food group. Secondly, even if there is provision for children to add other foods to the list, a child may not remember foods without a prompt. Thirdly, portion sizes are usually taken as standard portion sizes based on studies in adults and these are likely to be different for children. Also, there are likely to be differences between the sexes and for children of different ages. The task of developing standard portion sizes for all the ages and for both boys and girls would be expensive and time consuming. Finally, young children need a short time frame in order to estimate food frequencies, therefore the FFQ may only be measuring recent diet rather than usual diet.

Food frequency questionnaires tend to overestimate nutrient intakes even in adult populations. For example, Bingham *et al.* found that two different FFQ's, completed by women aged 50-65, overestimated non-starch polysaccharides (NSP), fibre, potassium, and carotene when compared to a 16 day weighed record, largely due to over-reporting intakes of vegetables and wholemeal bread (Bingham *et al.*, 1994).

Arnold *et al.* developed a food frequency questionnaire for 7 to 12-year-old girls, based on an adult FFQ (Arnold *et al.*, 1995). The questionnaire was sent home with the girls. This was followed up by a visit from a trained interviewer who reviewed the completed questionnaire and gave instructions for completing a 7-day food record. The FFQ and food record were repeated approximately 6 months later to test the reliability. Seventy-five percent of the questionnaires were completed by the parents, a further sixteen percent by both parent and daughter together. Similar completion rates were obtained for the 7-day records. The test-retest correlations were 0.5 or higher for 10 out of the 16 nutrients examined. Compared to the 7-day records, the authors concluded that the FFQ overestimated nutrient values, although it was not made clear how the food record was quantified.

In a calibration study of 9 to 12-year-old children in northern Italy, children filled out a FFQ with help from their parents and the adults completed the weighed record. The results showed that, even with adult supervision, energy, vitamins B1, B6, C, and fibre were significantly overestimated (Bellu *et al.*, 1995). One of the problems with using parental assessment of a child's diet is that the parent may not be aware of everything the child has eaten and this may bias the dietary record.

Food frequency questionnaires analysed by foods and food groups tend to overestimate frequently consumed staple foods, but underestimate snack foods. A Swedish study compared a FFQ with a 7-day record in thirty 2 to 16-year-old children. Parents completed the FFQ and parents, children and school staff filled in the food record (Blom *et al.*, 1989). The food records were "translated" into FFQ responses and the two methods compared. Blom *et al.* found that the frequency of intake of staple foods was often overestimated by the food frequency questionnaire, while the frequency of meat, sausage and some sweet snacks was

underestimated. When foods were combined into groups characterised by nutrient content, there were correlations of between 0.52 and 0.76 between the FFQ and the 7-day record. The researchers concluded that the validity of the questionnaire was limited for individual foods, but that the validity of groups of foods was better.

A British study compared the relative validity of a 35 item FFQ with 14 day records completed by parents of children aged 5 to 11 years (Hammond *et al.*, 1993). They found that parents tended to overestimate on the FFQ foods that might be considered 'healthy' (fruit and vegetables) and underestimated the consumption of 'less healthy' foods (cakes, sweets and chips). The study found that foods eaten more frequently (3-7 days per week) were, on average, less accurately classified that those eaten less frequently.

Field *et al.*, in a study of fourth to seventh grade children, found that there was poor correlation between a FFQ and the median of four 24-hour recalls in the younger children (Field *et al.*, 1999). They concluded that fourth and fifth grade children have not mastered the basic reading and mathematics skills required and are not sufficiently developed in abstract thinking in order to complete a FFQ.

Food frequency questionnaires are unlikely to be of use with prepubescent children unless parents are actively involved in their completion. The need for parental co-operation means that the FFQ has to be done outside the classroom. This may lead to bias if, for example, those with a poorer diet are less likely to return the questionnaire, or their parents deliberately over- or under-estimate the foods the children eat. Where children have a limited ability to estimate the quantity of foods eaten over a long period of time, FFQ's become less accurate at determining usual diet. Even if this method was feasible with prepubescent children without parental input, since children typically have more changeable food patterns than adults, it may only classify them over the short term.

1.7.4.3 Direct observation

Direct observation could be used to determine what children eat. The method is not reliant on the child, and so avoids the problems of memory, cognition, and the written or verbal skills which the child may need for other methods. Direct

observation has the advantage of allowing the researcher to develop an accurate picture of the types and amounts of foods eaten.

If the aim of the study is to determine portion sizes, then observers need intensive training to be able to make accurate and consistent estimates. This may be particularly difficult where the observer is trying to observe discretely. In an observation of school packed lunches there were no significant differences between the mean energy, fat, sodium, vitamin C and vitamin A levels recorded by two trained observers. Interobserver differences in portion size accounted for a greater proportion of the difference in nutrient values than interobserver differences related to identification of food types (Simons-Morton *et al.*, 1992).

In a review of direct observation of dietary practices in children, Simons-Morton and Baranowski concluded that the approach was useful for specific meals, in institutional settings, for children too young to recall their diet, where there may be the potential for bias in self-reported diets, or as a measure of validity for a self-completed method (Simons-Morton and Baranowski, T., 1991).

One disadvantage of direct observation is that little is known about the impact observation may have on a child's usual eating habits and how this may bias the results. Finally, the method is time-consuming, labour-intensive and expensive, therefore it is not practical for large population studies. However, it may be useful for validation studies or to identify specific issues.

1.7.4.4 24-hour recalls

The 24-hour recall method assesses current diet but only for a specific day. Properly conducted 24-hour dietary recalls for a large sample can give relatively good population estimates. However, single 24-hour recalls do not measure the usual intake at the individual level as they tend to exaggerate the estimates of individual variation (Beaton *et al.*, 1979). Repeated 24-hour recalls, allowing for different days of the week and different seasons, can give a better indication of an individual's habitual diet. As they can be quick and relatively easy to complete, they may be a useful tool for obtaining dietary information from prepubescent children. Most 24 hour recalls carried out with prepubescent children have involved lengthy interviews with trained staff, sometimes in the presence of a parent (Ellestad-Sayed *et al.*, 1977a; Ellestad-Sayed *et al.*, 1977b; Haraldsdottir

and Hermansen, 1995; Melnik *et al.*, 1998; Musaiger and Gregory, 1992; Rasanen, 1979; Simons-Morton *et al.*, 1997; Todd and Kretsch, 1986; Van Horn *et al.*, 1990).

Some studies used a non-quantified food diary as a memory aid for their 24 hour recalls (Eldridge *et al.*, 1998; Lytle *et al.*, 1993), although it has been suggested that the use of a food record may call attention to, and affect, the number of servings consumed (Lytle *et al.*, 1998). The majority of studies estimate portion sizes with the aid of food models, household measures, photographs or a combination of these methods.

Validation studies of children's 24-hour recalls have shown different results. Carter *et al.* found a significant difference between observed and recalled mean values for energy and protein in a group of 10 to 12-year-old children (Carter *et al.*, 1981). However, a study of new immigrant and refugee children aged 8 to 11 in America found that the children's recall ability compared to that observed was only partially successful but was similar to adults (Todd and Kretsch, 1986). A study of third grade children using food records, found that they were able to recall approximately 78% of foods (Lytle *et al.*, 1993). Lytle *et al.* found that there was no significant difference between recalled and observed nutrient intakes on a nutrient density basis but the estimation of portion sizes was difficult.

Van Horn *et al.* found good correlation between written reports by parents and 24-hour recalls by 6 to 10-year-old children for both nutrients and food group frequencies and portion size. Although most foods had similar under- and over-reporting rates, some food groups were more accurately recalled than others. For example, candy was more often under-reported by children, whereas vegetables were more often over-reported (Van Horn *et al.*, 1990).

A Danish study looked at repeated 24 hour recalls in 25 eight year olds and found that, compared to a dietary history obtained from parents, there were similar group means for energy and macronutrients (Haraldsdottir and Hermansen, 1995). However, the two methods did not rank the children identically. Between 28% and 76% of children were ranked in the same third for energy and macronutrients, and between zero and 20% were in opposite thirds. Some reported food intakes

were found to differ systematically between parents and children. In particular children reported significantly fewer vegetables than parents.

One of the major problems with 24-hour recalls as an assessment tool, is poor memory. Many studies, including adult surveys, have found that foods have been omitted, either mistakenly or deliberately, or have been recalled when they were never eaten (Dwyer *et al.*, 1987; Lytle *et al.*, 1998; Todd and Kretsch, 1986; Van Horn *et al.*, 1990). Even when foods are recalled, estimates of the quantities are frequently inaccurate.

Parental involvement may be an option. Eck *et al.* found that the best dietary estimate was a consensus between parents and children (Eck *et al.*, 1989). Measurement reactivity may be a problem: if children are interviewed in the presence of a parent or teacher, they may exaggerate the number or amounts of foods that they consider to be 'healthy' foods and under-report 'junk' foods. Other factors which are particularly relevant to children and which may affect recall are age, intelligence, attention span, and the frequency that specific foods are consumed (Krall *et al.*, 1988).

1.7.4.5 Weighed records

Weighed records are frequently used as a reference measurement. They are considered to be the reference measure of choice, since they are carried out prospectively and do not rely on participant's memory. However, even prospective studies may be subject to bias. People may consciously or unconsciously change their usual dietary habits during the recording period or over- or under-report their intake, thereby affecting the results. Livingstone *et al.* found a significant difference in adults between reported energy from weighed dietary records and energy expenditure calculated by the doubly-labelled water (DLW) technique (Livingstone *et al.*, 1990). The difference was particularly evident in those with a low or medium recorded intake of energy.

Another validation study of energy intake calculated by weighed records and energy expenditure (estimated using DLW) carried out with 7 to 18-year-old children, found that for the 7 and 9-year-olds, energy intake from weighed records and estimated energy expenditure were in close agreement but that the values diverged increasingly with age (Livingstone *et al.*, 1992). It should be noted that

the weighed records for the 7 and 9-year-olds were completed by their parents whereas the adolescents took their own measurements.

Probably the most comprehensive recent British study of diet in children was carried out in the early 1980's (Department of Health and Social Security., 1989). More than 1700 seven-day weighed records were collected from a representative sample of 10 to 11-year-olds in England and Wales. Initially, parents were interviewed about the child's usual eating habits and family circumstances. The child then kept a 7-day weighed record. The fieldworker returned within 24 hours to check the details and probe for more information. The fieldworker then returned periodically during the week to check the record. For those children who found recording difficult the fieldworker checked the record daily. The survey was conducted within local authority maintained schools and achieved a final response rate of just over 75%.

Due to the complex and time-consuming nature of weighed records, they are not useful for large-scale epidemiological studies, but they could be used as part of a calibration study. If they were to be used with prepubescent children then it would be prudent for the children to be supervised by their parents. This requires parental commitment and may lead to a bias in reporting. It is also necessary to establish whether there are any anthopometric or demographic differences between those children who take part in the weighed record and those who do not. This would involve additional questionnaires, time and expense.

1.7.4.6 Food Diaries

Food diaries are a prospective record of the diet. They can be as basic as recording the foods eaten each day, or more complex with the addition of estimated portion sizes. Hackett *et al.* found that a three day food diary, quantified using household measures, together with an interview, gave a good estimate of the mean dietary intake of 11-year-old school children (Hackett *et al.*, 1983).

Gilman *et al.* tested the feasibility of using food records with fifth graders and found that they were competent in completing multiple days of food records (Gillman *et al.*, 1994). However, the adequacy of the information was not validated. A comparative study of 3-day food records and lunchtime observation of 9 to 10-year-old girls found both under-reporting (median 25%, interquartile

range 16-31%) and reports of foods not eaten (median 10%, interquartile range 0-26%) (Crawford *et al.*, 1994). A US study of fourth and fifth graders used a daily or weekly monitoring approach to check food records (Domel *et al.*, 1994a). Records were kept for periods of between 14 and 23 days. Validation of the results was achieved by comparing food records with a direct observation of school lunches. For those monitored daily, the results showed that for eight out of the nine meal items, correlations between observations and records were significant and ranged from 0.16 for grain products to 0.85 for non-fruit desserts. The results were less accurate for those children monitored weekly. The results indicated that under-reporting was more common than over-reporting.

The advantage of food diaries is that they are relatively cheap to produce, simple to complete and do not rely on the memory of the subject. Unlike weighed records, the amount of supervision required is minimal. However, it would be advisable to review the diaries of prepubescent children on a daily basis while details are relatively fresh in their minds. The disadvantages of food diaries are that a lot of time needed to code and analyse the data recorded, and there is the possibility of transcription errors. For large-scale studies of food diaries over several days, the cost of data analysis is relatively high.

1.7.4.7 Checklists

Checklists are a technique similar to food frequency questionnaires but carried out prospectively. A list of foods (usually derived from focus group work and pilot studies) is presented for each day that recording takes place. The subject then records the number of times a particular food was eaten on the day in question but is not required to state the amount eaten. The checklists are then analysed using standard portion sizes. This technique is relatively new and not fully tested.

As with food frequency questionnaires, checklists are limited to the range of foods listed. This may be a disadvantage, as foods that are not specifically mentioned may not be recorded. If the checklist is to be quantified, portion sizes become an important question. Standard adult portion sizes may be inappropriate for prepubescent children.

1.7.4.8 Validation, calibration and reliability of assessment methods

It has been said that one of the problems in the nutritional field is the lack of validation or calibration studies to provide data for assessment and correction of measurement errors (Kohlmeier, 1994). In this section the issues of validity, calibration and reliability of food-based dietary assessment tools are discussed.

The validity of an assessment method is its ability to measure the 'true' situation. Measuring the absolute 'truth', in terms of both dietary behaviour and nutrition knowledge is impossible, as all measurements will include a degree of error. Margetts and Pietinen (1997) stated that a proper validation study is one which determines the relevant measurement errors of the relationship between 'true' exposure and that derived from a test measurement model. Assumptions about a set of unknown statistical parameters of a measurement model are made *a priori* and used to separate out different sources of measurement error. This requires at least two independent reference measurements.

The comparison of a test measure with a single external standard or reference measure (which is believed to be close to the 'truth') is known as a calibration study. A calibration study is designed to assess the statistical parameters required in order to correct the measurement errors of given incremental changes in exposure between the reference and test methods. A calibration study is only part of a validation study.

Ideally a validation study is conducted under exactly the same conditions as the new or test measure will be used. This is difficult to achieve. The reliability of a measure is assessed by the repeated administration of the method under identical conditions. A measure may be reliable, but not valid; it may consistently measure the exposure of interest, but this measure of exposure may not relate to the true exposure.

The purpose of this thesis is to develop tools which are able to measure food patterns in prepubescent children in terms of knowledge and behaviour. What is required is a measure which will provide valid information at the group level in order to monitor whether programmes aimed at improving diet or nutrition knowledge achieve any change in dietary patterns or knowledge.

In order to validate a new method it is important to consider the assumptions implicit in the validation process:

1. Is the reference method an appropriate measure of relevant exposure? What we are looking at is the ability of the test method to categorise children in the same groups as the reference measure. If we wish to determine dietary behaviour or knowledge at a group level, then it may be sufficient to categorise individuals rather than obtain an absolute measure. Therefore, if we want the tool to be able to measure gross food patterns (for example, we want to be able to measure the number of portions of a fruit without knowing the exact type of fruit) then the reference method should also be capable of measuring the same gross food patterns rather than individual nutrient data. What is important, is that the measurement errors implicit in the reference method are independent of those of the test method. If we were looking to estimate an individual child's dietary intake, then the estimation of portion sizes, intrapersonal variation, seasonality and days of the week may need to be taken into consideration. At an individual level, the problem of wide intrapersonal variation could be largely overcome by collecting a few repeated measures of intake and calculating the between- to within-subject variance ratio. When using dietary information to look at the relationship between diet and disease, an estimate of the true correlation can then be obtained from the between- to within-subject variance ratio (Borrelli *et al.*, 1989). This can then be used as a correction factor for the correlation coefficient of diet to disease at a population level. It should be noted however, that this does not correct for any bias which may be present in the method. To identify the relationship between diet and disease a dietary assessment method must have both specificity and sensitivity. If we are looking to rank prepubescent children according to their food intake then the method must be able to correctly identify which children belong to which intake range (sensitivity) and which children do not belong to that group (specificity). The relative sensitivity and specificity of a new assessment method can be established by comparing it with a reference standard.

2. What are the errors associated with the assessment methods? All measurements will include some degree of error. For example, weighing scales may not be accurate, the amount of waste food may not be recorded correctly, cooking methods will affect nutrient content, or one individual's ability to metabolise a nutrient will differ from another's. The objective is to recognise and allow for correction of those errors, calibrating the new tool against a reference standard. The aim of calibration is to minimise the variance between the two measures.

3. Are the errors independent? If the errors in the reference measure with reference to the 'truth' correlate with those of the test measure, then the test measure will appear to be a good representation of exposure, but they may not necessarily correlate well with true exposure. Assuming the errors from a reference measure and an assessment method are independent, estimates of the correlation, true variance and required scaling factors can be derived. For example, if the errors in the information collected for validation purposes from parents is independent of errors in the data recorded by children, and the parental information is reliable, we can identify possible systematic bias in reporting by food group and adjust for it.

4. What period of time is required to provide a reliable estimate of 'usual' food patterns? The number of days required to provide a valid representation of the diet by food group is not known, however it is likely to be less than the number of days needed to validate nutrient intakes, but may vary with food group. Ideally, to validate a food diary, for example, children would complete a diary for a number of days, then the same children would complete a weighed record for the same number of days. The time between the application of the food diary and completing a weighed record should be short enough so that the children have not developed a new repertoire of foods but far enough apart that the record is not biased by any learning effect.

5. Is there any bias? There are several areas where bias may be introduced into a study. Firstly, the selection of children for the study may not be representative of all UK 9 to 10 year olds. Secondly, if children within the study are self-

selected volunteers they are likely to be more motivated and may be better supported by their parents. However, a non-representative sample will not necessarily affect the internal validity of the study. Thirdly, the information provided by the subjects may introduce random or systematic bias between comparative groups. Systematic differences are a problem insofar as the may lead to under- or over-estimation of the results. For example, two comparative groups of children differ in the amount of detail they provide or thin children report differently to fatter children. Fourthly, when collecting dietary data, if a proportion of the children do not return dietary information then it needs to be established whether there is any bias between the children who complete the task and those who do not. The comparison of demographic and anthropometric data provides a means of identifying possible differences between the groups. Finally, bias may be introduced if the researcher systematically records or prompts children in one group more thoroughly than those in the comparative group.

6. What reference measures may be appropriate? Biochemical markers can be used, in a limited way, as a measure of validity for other dietary assessment methods. However, as biochemical markers measure nutrients and nutrients are derived from more than one food source, biochemical analysis is not useful in the validation of food-based dietary assessment tools. Direct observation could be used as a validation method. If the assessment is to be conducted within the school, it may be possible to observe the children at lunch and then compare the information to the details supplied by the children. However, direct observation may cause the children to change their usual eating patterns; for example, their usual practice may be to leave any fruit they have but eat it when observed. Another difficulty is that it would not be possible to observe those children who went home for lunch. If records from these children differed systematically from the children observed at lunch the results may be biased. Weighed records are frequently used as a reference standard by which to measure a new assessment method. Although weighed records are not a perfect measure of 'true' intake, they can be used to assess a wide range of foods and nutrients. If we are concerned with identifying the balance of foods between food groups then, at the class level,

it may be sufficient to use information gathered from parents as a standard by which to measure children's dietary information.

7. What is the relative validity of the analysis database? If we are using the 'Balance of Good Health' guidelines as the basis for food-based analysis, it is important that the output of the database be capable of depicting the data in a manner consistent with the 'Balance of Good Health' plate. That is, if the balance of a child's diet is in line with current dietary recommendations, then the output from the database should produce a pie chart of similar proportions to the 'Balance of Good Health' plate. At the group level, it may be sufficient to rank prepubescent children, by intake, by food group. Using weighed records as a reference measure, the relative validity of the database can be established by comparing quintiles of gram weights of foods with the number of portions allocated to each food group. The database may be deemed acceptable if, for example, it is capable of ranking more than two thirds of the children to within + or – one quintile of the ranking of food weights. The use of a food-based database, rather than a nutrient database, means that the information cannot be used to measure nutrients directly. However, it may be possible to use food groups as proxy measures of specific nutrients. Using weighed records to calibrate the food groups could provide estimates of the correlation between specific nutrients and related food groups.

1.7.4.9 Summary of current dietary assessment methods

Traditional dietary assessment methods have focused on determining the nutrient content of the diet as opposed to establishing food patterns. However, there is no reason why any of the methods reviewed could not be adapted for use with food groups. In studying diet in prepubescent children, the limiting factor is the suitability of the tools.

Most of the methods for obtaining dietary information have been developed for use in adult populations. Other than biochemical markers, dietary assessment tools are subjective and thus rely heavily on the ability of the respondent to correctly recall or record the types and quantities of food consumed. Subjects are often required to aggregate different types of foods, to have knowledge of different food composition (e.g. type of milk or margarine), and to correctly interpret the

questions being asked by the researcher. The subject also needs to be able to communicate in such a way that the researcher clearly understands their intended meaning.

Children often lack the skills to communicate effectively. By the age of ten, children are linguistically competent in the grammatical sense, but they may not be able to employ language in a functional setting (Krauss and Glucksberg, 1969). Kohlmeier made the point that there is still a need for accurate subjective measures of dietary intake (Kohlmeier, 1995).

With consideration to the cognitive and communication skills of prepubescent children two dietary assessment tools appear to have the potential for use within this age group. Firstly, a retrospective 24-hour recall and secondly, a prospective food diary. The aim of this project is to develop a range of appropriate dietary assessment tools for use with prepubescent children. Therefore, this project will examine ways of adapting the recall and food diary methods for obtaining food group data from prepubescent children to monitor food patterns. Further research will be required in a larger population to validate and calibrate the methods.

2 Preliminary Work in the Development of Dietary Assessment Tools

Objective

2. i) Identify usual food patterns and eating habits of prepubescent children.

   ii) Identify appropriate methods for prepubescent children to communicate dietary information.

   iii) Examine the capability of prepubescent children to estimate portion sizes.

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The preliminary studies involved three parts and were mainly carried out at a school in one of the outer suburbs of Southampton. The school-based work was undertaken during the 1995/6 academic year and the first term of 1996/7.

Firstly, discussion groups were set up with children and parents not involved with the study school. Discussion groups also took place with teachers and catering staff from the study school. These groups focused on usual foods eaten and meal patterns (Section 2.2). This information was used to establish a food type questionnaire and to indicate the most appropriate way to collect dietary information from prepubescent children. Secondly, a class of 9 to 10-year-olds took part in a school lunchtime session to identify food consumption patterns (section 2.3). The issue of the perception and conceptualisation of portion sizes among prepubescent children is examined in section 2.4. Several methods were explored to determine which, if any, were suitable for this age group. Finally, section 2.5 summarises the chapter.

2.1 Introduction

Dietary assessment tools are vital in the evaluation of dietary behaviour. The tools must be both reliable and valid for use in the population they are intended. Dietary assessment usually measures nutrient intake. However, many current health education messages are in terms of a balance of foods, as with the UK 'Balance of Good Health' guidelines. These guidelines depict the relationship between the five groups; bread, cereal and potatoes, fruit and vegetables, milk and milk products, meat, fish and alternatives and fatty and sugary foods. It would, therefore, be appropriate to analyse dietary information in terms of foods and to produce feedback in a form compatible with the 'Balance of Good Health' food groups. This format would be particularly appropriate for prepubescent children as they can relate to foods but may have insufficient knowledge to understand nutrient-based information.

2.2 Using Discussion Groups to Identify Food Types and Meal Patterns

Discussion groups are a useful way to begin researching into people based issues and can be used as a forerunner in developing nutrition education and dietary assessment tools. Discussion groups are useful for allowing people to explain things in their own language, with their own cultural biases and are not reliant on literacy skills. The discussion groups used in this study were based on a more formal 'focus group' strategy but without tape-recording and direct transcription of the discussion. Focus groups are a form of group interview that allow for interaction between the participants which can lead to further discussion (Kitzinger, 1995). They can be used to generate hypotheses or develop and test ideas or questionnaires (Mahoney *et al.*, 1995; Pucci and Haglund, 1992).

The potential advantages of discussion groups are; firstly that they encourage participation from those who may be reluctant to talk during individual interviews, secondly they can encourage contributions from those who may otherwise feel that they have nothing to say. Finally, as stated above, they do not require reading or writing skills. The disadvantages are that they may suppress a dissenting voice (with individuals sticking to the 'group norms') and they may compromise confidentiality. Group discussion work is a qualitative rather than a

quantitative technique. It can act as a catalyst for further research. The use of discussion groups is particularly appropriate for children as it allows for expression of ideas without the complication of poor written communications.

The optimum number for a focus group of younger children is said to be four to five (Hoppe *et al.*, 1995). Any more than that and it becomes difficult to keep their attention and to bring in the quiet ones. Focus groups for adults should consist of between six and eight people, which is considered to be the ideal size for group discussion (Kitzinger, 1995). It has been suggested that focus groups for children work better when the group is of a single gender and with a facilitator of the same sex (Hoppe *et al.*, 1995). The same study also found that where groups comprised of a number of friends children were more likely to talk to a stranger and express their opinions more freely. These principles were adopted for the discussion groups in this research.

For the study it was necessary to set up three separate discussion groups i.e. children in the age group 9 to 10; parents of this age group; and teachers and school meals personnel. All the discussion group sessions were semi-structured. This was particularly important with the children where spontaneity was probably more important than an orderly discussion.

2.2.1 Methods

The discussion group sessions lasted between one and two hours and took place in a suitable location for each individual discussion group. The aim of the sessions was to establish a list of 'usual' foods eaten, to identify eating patterns and determine the most appropriate way to help children record their diet.

The facilitator was aware of the aims of the session and if one avenue of discussion did not elicit the information then they would steer the group down a different path. The facilitator used non-directive probes throughout the meeting.

Table 5 shows the agenda and Table 6 the activities for each discussion group session.

Table 5: Agenda for the discussion groups

1. Introduce self and any other members of the research team.
2. Explain about the project. (Depth of explanation dependent on age group).
3. Get everyone to make their own nameplate. This is a 'warm up' exercise and helps the facilitator to address the participants by their name.
4. Lay down the 'Ground Rules' (adapted to suit age group).
   * this is not a test and there are no right or wrong answers
   * everyone is entitled to their own opinion and everyone's opinion is of equal value
   * no one is allowed to say that another person's answers are wrong
   * everyone is to be given a chance to say something
   * all the information is to be confidential
5. Conduct the session.
6. Allow time for questions at the end.

Table 6: Discussion group activity chart.

Activities with children	Activities with parents	Activities with school meals personnel (inc. tuck shop staff) and teachers
Draw pictures of diet in the past 24hrs. Discuss how many things other members of the group eat. List foods. Food 'game': children allocate foods to 'Balance of Good Health' food groups.	Discuss what children in this age group tend to eat and the freedom of choice they have and their ability to purchase foods outside parental control. How much influence do the children have on the foods purchased and consumed by the family.	General discussion of the impression these staff have of the types of foods eaten, either brought from home, bought at the snack bar or consumed as a school lunch. Find out about school meal recipes and the quantities served.

2.2.2 Results of Discussion Group Work with 9 to 10- year-olds

A discussion group was set up with four children, three girls and one boy, aged 9 to 10 years old. They were from white middle class families from an urban area. The children were friends and all attended the same school. From preliminary discussions it was clear that they were able to take part in a verbal group discussion without the need to draw and write. The session started by looking at foods by meal pattern rather than by specific food groups as this was found to provided better information. It was decided that the session would take the form of a discussion about what they usually ate, followed by a drawing session if time allowed.

The session was held after school at the home of one of the participants. The room was quiet, without distractions and all the children were familiar with the surroundings. No parents were actually present in the room at the time of the discussion. The children sat around a large table either side of the facilitator (KIP). The children were introduced to the facilitator and names were exchanged. We had drinks and a snack and began with a general chat to put the children at ease. The children were then told a little bit about the study and encouraged to ask any questions. At this stage it was emphasised to the children that they were a very special group and that their information would help to establish the basis for the rest of the study. Once the children were settled and comfortable the discussion group work began.

The children recognised that they had different eating patterns on school days compared to the weekend so the facilitator confirmed with the group that the best way to describe what they ate was to divide the discussion into time periods. Firstly to look at school days by breakfast, morning break, lunch, after school, evening meal, and in the evening before going to bed. Secondly to look at weekends by breakfast, during the morning, mid-day meal, during the afternoon, evening meal, and in the evening before going to bed.

The session was conducted in a semi-structured fashion using an A1 sheet of paper for each meal/snack occasion and the children were asked what they ate while the facilitator noted it down. In order to avoid repetition and prevent boredom when the children mentioned, for example, a food item for breakfast

they were asked if this applied to weekend days as well as week days. Any missing foods eaten at weekends were filled in after completing the food list for school days. The children were also questioned about packed lunches and school dinners.

The session lasted about 50 minutes. At this stage the children were keen to use the large marker pens used by the facilitator to record the data. It was therefore, an ideal opportunity to get the children to draw their 'favourite' meal to see if they were capable of reproducing a meal that could be interpreted by the researcher.

Results of the food list produced are shown in Table 7, page 51.

Table 7: Results of the discussion group with 9-10 year old children

Meal/ snack time	School days	Weekends
Breakfast	toast (preferably white) with butter and jam/chocolate spread/ paté cereal with whole or semi-skimmed milk fruit juice, hot chocolate	toast (preferably white) with butter and jam/chocolate spread/ paté crumpets, croissants cooked breakfast -egg, bacon, sausage, beans, mushrooms fruit juice, hot chocolate
Morning	chocolate bars, biscuits, cake, or savoury snacks (crisps etc.), squash	chocolate bars, biscuits, cake, sweets or savoury snacks (crisps etc.), squash
Mid-day meal	Packed Lunch white bread with butter/marg, tuna, paste, turkey, chicken, ham, cheese salad vegetables (occasionally) savoury snacks (crisps etc.) yoghurt, fromage frais chocolate bars, cake, squash, choc-milk, fizzy drinks, soup bought at school School Dinners sausages, chicken nuggets, burgers, baked beans spaghetti hoops potatoes - roast, mash, chips peas, cabbage, carrots, salad fruit pie/crumble, custard, cake, muffin, ice-cream, jelly, yoghurt, fruit	Home soup sausages, scrambled egg bread, toast, crumpets meat - roast, casserole potatoes-roast, boiled, yorkshire pudding peas, carrots, cabbage rice pudding, yoghurt, apple, pear, biscuits Eating Out burgers, chips milkshake
After school / afternoon	sweets, chocolate bars, chocolate biscuits, savoury snacks (crisps etc.) coke	chocolate biscuits, savoury snacks (crisps etc.), toast (with butter and paté), cereal apple, pear coke, milk, orange juice, squash
Evening meal	soup mince dishes (lasagne, shepherds pie, bolognese) burgers, sausages, pizza, chicken nuggets, meat pies, roast meat, fish fingers, eggs - fried, omelette potatoes - chip, mash, boiled peas, carrots, sweetcorn rice pudding, mousse, ice-cream	Home cheese on toast, omelette, pizza tomato sauce mousse, rice pudding Take away Fish and chips Indian Chinese (not often)
Before bed	cheese on toast chocolate biscuits, sweets apple, pear, orange, banana ribena, water	cheese on toast, cereal chocolate biscuits, sweets apple, pear, orange, banana ribena, water

2.2.3 Results of Discussion Group Work with Parents

Following the session with the children a discussion group was set up with the parents. Again this took place in a quiet environment and without the presence of the children. Following an informal discussion over coffee the session began by explaining the project further and setting ground rules. A general discussion ensued and the parents all agreed that, on the whole, the children did not substantially influence the foods purchased. Generally the children were encouraged to eat a variety of foods similar to the foods normally eaten by the adults in the family. However, some allowances were made for more exotic or highly flavoured foods. It was felt that the children had experienced a broad range of foods but that there was a preference for high fat and sugar foods.

The use of low fat and sugar foods was explored. In this particular group of parents the use of low fat spreads, low fat milk and sugar-free soft drinks was common. Chips were usually oven-baked and grilled foods were more common than fried foods in the home. This was the general household consumption and no special allowance was made for the children.

At the end of the session, unbeknown by the children, their food lists were shown to the parents. The parents stated that the children forgot many of the foods they ate. This may be due to poor short-term memory and that those foods recalled were the ones eaten most recently or it may be that the children tended to recall the foods they liked best. The parents also seemed to feel that there was an over emphasis on the amount of sweets, chocolate bars, biscuits and cakes that they ate. As it was not possible to validate this information this area requires further research. However, the discussion groups did highlight the major food types eaten by this particular group of children and gave useful knowledge to building up a database of commonly consumed foods in this age group.

2.2.4 Results of Discussion Group Work with Teachers and Catering Staff

Two teachers and four catering staff from the local primary school were recruited into a discussion group. The catering supervisor provided details of all the menu options for the cooked meals and a list of the types of foods provided at the 'snack' counter (examples in Table 8). The school provides a selection of snack

foods that are intended to supplement foods brought from home. Staff tried to encourage children to choose a varied menu but with approximately 120 children per sitting this was not always easy.

The school has a policy of providing healthy options that comply with the national 'Heartbeat Awards'. The 'healthy' choices were highlighted on the menus which were put up in the classroom each week. Table 8 shows an example of a typical school menu for three days.

Table 8: Examples of school menu options as prepared by the external caterers

Breaded fish fillet or ♥ Fish cake	♥ Traditional pizza	♥ Turkey roast with gravy
Pork and chicken sausage	Chicken nuggets	Sausage roll
♥ Mashed Potatoes	♥ Parsley potatoes	Roast potatoes
Potato waffle	Croquette potatoes	♥ Bread or roll
♥ Garden peas	♥ Sweetcorn kernels	♥ Fresh cabbage
♥ Carrots	♥ Baked beans	♥ Mixed vegetables
♥ Side salad or Variety salad		
♥ Fruit and custard	♥ Fruit rocky mountain yoghurt	♥ Fruit in jelly
Decorated sponge	Homemade cookie	Treacle carrot cake
SNACK BAR: Cheese and biscuits, mousse, ♥ yoghurt, ♥ fresh fruit, ♥ jelly, ♥ fruit juice, biscuits, ice-cream, ♥ flavoured milk A selection of these offered daily but no more than 4 pudding choices in total on any day		
♥ **HEARTBEAT CHOICES:** The dishes indicated above comply with the nutritional standards required by the Heartbeat Award, they are low in fat and, where possible, high in fibre and low in sugar		

It is school policy to allow pupils to eat only fruit at morning break. One of the issues discussed was the frustration, as a result of financial limitations, of not always being able put into practice some of the healthy options (such as the provision of a variety of fresh fruit at lunch time). The staff found that children did want fresh fruit and when a trial was run they had often chosen to eat fruit. Financial constraints, in this respect, were resulting in mixed messages with regard to healthy eating.

The teachers and catering staff stated that most of the lunch boxes brought in from home contained a savoury snack such as crisps, a cake or chocolate bar, and a fruit drink. This may be an appropriate area to increase nutrition knowledge by using health promotion material on healthy packed lunches.

Summary finding

Discussion group work provided background information about foods typically eaten by this population of prepubescent children. These data were used as the foundation for the food-based database.

The discussion group work with children also indicated that an appropriate method to record dietary information was by meal and snack periods.

2.3 Observation of school lunch

The school environment provides a unique opportunity to observe the eating habits of children at lunchtime and to collect qualitative data to enhance further quantitative research. This sections describes a method of direct observation and the findings of an observation study carried out in June 1995.

2.3.1 Method

As part of their cross-cultural studies, the 'Y5-95' class of 9 to 10 year olds had spent several weeks making a video to send to a twinned school. It was decided to take advantage of this and include a session 'at lunch'. The children were familiar with the researcher who had been working with them during the term. The video operator was introduced to the children at the beginning of the morning.

The children were first videoed in the classroom to refamiliarise them with the technology. They were then observed while they ate lunch at school. Children who went home for lunch were excluded from the study. The observation included twenty-five children who were having either a cooked meal, selecting food from the snack bar or bringing a packed lunch from home (Dataset 1).

The lunch times for the class were staggered so that the observation team saw six to seven children at a time. The children were asked to describe what they had, for example what filling they had in their sandwiches, what type of drink they had, and all foods were recorded. At the end of each session the children were asked to put any wrappers and leftovers in a pre-numbered bag. These were then collected and a note made of anything not eaten. The wrappers were used for clarification.

The foods were allocated to the appropriate food group each time it was eaten.

2.3.2 Results

Of the twenty-five children observed, sixteen (64%) brought packed lunches from home. Only two (8%) of the children had a cooked lunch (fish fingers, potatoes, vegetables and a cream bun). The remaining seven children (28%) ate foods solely purchased at the snack bar. Table 9 shows the breakdown by food and by food group for the seven children (A to G) who ate foods from the snack bar only. The foods chosen by the children are divided into the five 'Balance of Good Health' food groups.

Table 9: Foods eaten by children (A-G) selecting their lunch from the snack bar

Food group	Food	A	B	C	D	E	F	G
Bread, cereals and potatoes	Jacket potato (½)		✓		✓	✓		
	Hotdog roll	✓		✓				
	Crackers (2)						✓	✓
Fruit and vegetables	Salad	✓				✓		
	Water melon		✓	✓	✓			✓
Milk products	Cheese						✓	✓
Meat	Hotdog	✓		✓				
Fatty and sugary foods	Butter		✓		✓	✓	✓	✓
	Savoury snack	✓			✓	✓	✓	
	Sweet snack	✓	✓					✓
	Jelly			✓				✓
	Sugary drink	✓	✓	✓	✓ ✓	✓	✓	✓

All the children chose something from the bread, cereals and potatoes food group, either crackers, a hot dog in a roll or half a baked potato. Six of the seven children selected either a small dish of salad or a small tub of watermelon. All the children had at least two items from the fatty and sugary food group. Two children had a dessert, one had an iced bun and two others a chocolate covered biscuit. Four children bought a packet of cheese snack biscuits and all of the children bought a sugary fruit flavoured drink.

Some of the children who brought packed lunches from home, supplemented them with items from the snack bar. The most common items chosen were drinks and savoury snacks. Of the sixteen 'packed lunches' children, fifteen brought sandwiches or filled rolls (although one child did not eat their sandwiches) and one had cheese and crackers. Twelve of the children had a savoury filling such as meat, fish or cheese, one child had a savoury and a sweet sandwich, and two children had only a sweet filling. Two children had a salad vegetable in their sandwich and six children had fresh fruit. Two children had yoghurt and one other a milkshake drink. Twelve children had a savoury snack such as crisps, thirteen children had a chocolate bar, cake, biscuit or cereal bar. Ten children had squash, three children had pure fruit juice and one child had a glass of water. The average number of portions from each food group for the sixteen children having a packed lunch is given in Table 10.

Table 10: Average number of portions per food group for children eating packed lunches (n=16).

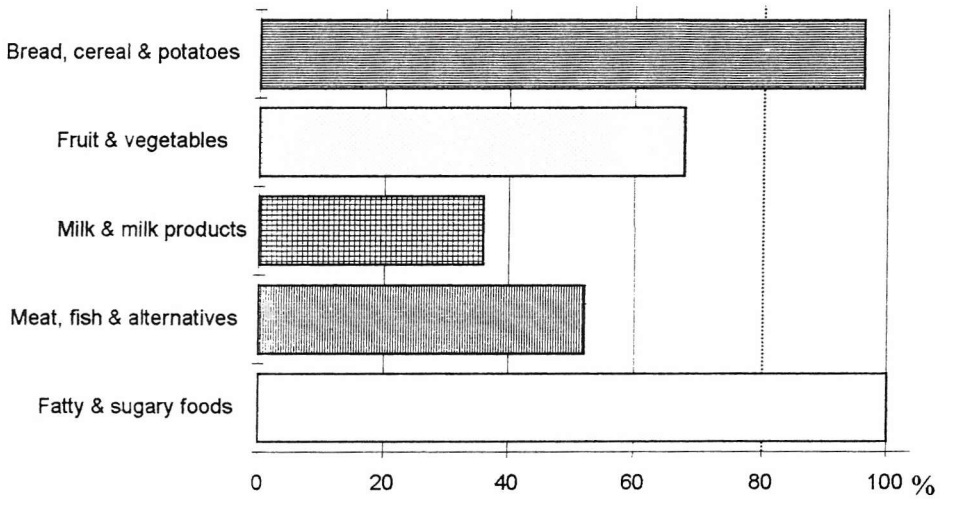
Food Group	Average number of portions
Bread, cereals and potatoes	1.0
Fruit and vegetable	0.7
Milk and milk products	0.3
Meat, fish and alternatives	0.6
Fatty and sugary foods	2.2

Taking the group as a whole, Table 11 and Figure 3 show the number and percentage of children having at least one item from the five different 'Balance of Good Health' food groups.

Table 11: The number and percent of children eating at least one food from each food group

Food Group	Number of children (n=25)	Percentage (%)
Bread, cereals and potatoes	24	96
Fruit and vegetable	17	68
Milk and milk products	9	36
Meat, fish and alternatives	13	52
Fatty and sugary foods	25	100

Figure 3: Percentage of children eating foods from each of the five food groups



For the study group as a whole, all the children had at least one item from the fatty and sugary group, and many of them had two or three items including a savoury snack, a sugar based squash and a sweet food. All but one of the children had something from the bread, cereals and potatoes group. The exception was a child who ate nothing but foods from the fatty and sugary group. A third of the pupils had nothing from the fruit and vegetable group, half had no meat, fish or alternative and nearly two thirds had nothing from the milk and milk products group.

2.3.3 Discussion

Direct observation is not a technique that can be applied in a large-scale study, but it could useful for validation studies or to answer specific questions (such as what sort of foods do children have for lunch). The use of a video as a means of direct observation has the advantage of allowing the researcher the opportunity of reviewing information that may have been overlooked at the time. The disadvantage of using a video, or indeed any other method of direct, overt observation, is that it may encourage the subject to change their habitual behaviour. However, it was felt that for this particular group of prepubescent children their familiarity with both the researcher and being filmed ensured a minimum of reactivity.

With the exception of the two children who had cooked lunch, the types of food eaten by the children at lunchtime were broadly similar. Overall, there was a large proportion of fatty and sugary foods consumed. However, analysing one meal by food group does not allow for a balance of other foods eaten during the day.

The small number of children having a cooked school lunch was not unusual for the time of year. The school allows 'picnicking' outside if the weather is fine and therefore a greater proportion of children bring packed lunches on fine days. The eating of packed lunches may have implications for some methods of dietary assessment. For example, if children are required to record their diet, then the point at which they record the food they eat is important. The children may record their packed lunch in the morning before going to school, but if any of the foods recorded were not actually eaten this may distort the analysis and could be a possible source of bias. Alternatively, they may share foods with their friends and this again would have implications for the analysis. Domel *et al.* found substantial trading of foods in a group of 4th and 5th grade students (Domel *et al.*, 1994a). In this particular observational study there seemed to be little swapping of foods and what was exchanged, was exchanged for a similar type of food which did not affect the food group allocation.

Summary finding - The results of the observational study confirmed the findings from the discussion group work of the types of foods eaten by this particular socio-economic group of prepubescent children.

2.4 Portion Sizes

Determining portion size is known to be difficult even in an adult population (Faggiano *et al.*, 1992; Robinson *et al.*, 1997). Various methods can be employed including the use of food models, household measures and photographs. The determination of portion sizes by prepubescent children, using food models, household measures and tableware, has proven difficult (Crawford *et al.*, 1994; Lytle *et al.*, 1993; Van Horn *et al.*, 1990). If there is a need to determine portion sizes for use with the dietary assessment tools in this study, then we need to ascertain whether prepubescent children are capable of providing this information by other means. The following section looks at possible methods for the determination of portion sizes and the skills required to provide the information. Section 2.4.1 aims to find out if prepubescent children have sufficient perceptual and conceptual skills to relay portion size data. Sections 0 and 2.4.1.4 relates to the development of tools using food photographs and computer images to determine portion size.

2.4.1 Perception and Conceptualisation

Nelson *et al.* (Nelson *et al.*, 1994; Nelson *et al.*, 1996) described the process of identifying portion size as involving three main elements: perception, conceptualisation, and memory. Perception relates to the ability of the subject to assess the portion size of an amount of food actually present. Conceptualisation refers to the subject's ability to identify the portion size when the actual food item is not present. Memory will affect the subject's ability to recall the food as well as the portion size. Memory plays an important part in the ability to recall diet. Lytle *et al.* found that children as young as 8 years old could largely remember what they ate the day before but they had difficulty quantifying the portion sizes of almost all foods even using three-dimensional food models, measuring utensils, and tableware (Lytle *et al.*, 1993).

To establish whether prepubescent children were capable of utilising these skills several methods were developed, namely the use of draw and tell, food photographs, and computerised images.

2.4.1.1 The accuracy of recorded portion sizes through drawings

To determine whether prepubescent children could accurately represent food portions they were presented with a series of food items and asked to draw them on paper in 'actual' size.

2.4.1.1.1 Method

Twenty-four of the 9 and 10-year-old children who had taken part in previous experiments were visited at school by the researcher at lunch time. These children formed Dataset 2.

At the end of the lunch session previously weighed and measured cake (Battenburg, Madeira, chocolate or coconut sponge) was distributed to the children. Each child had at least one piece of cake. The work was conducted as part of the observational study previously reported (Section 2.3, page 54). Immediately after the lunch break the children were asked to draw, 'in real size', everything they had eaten at lunchtime including any drinks. They were reminded that the cake they had eaten had to be included in their drawing.

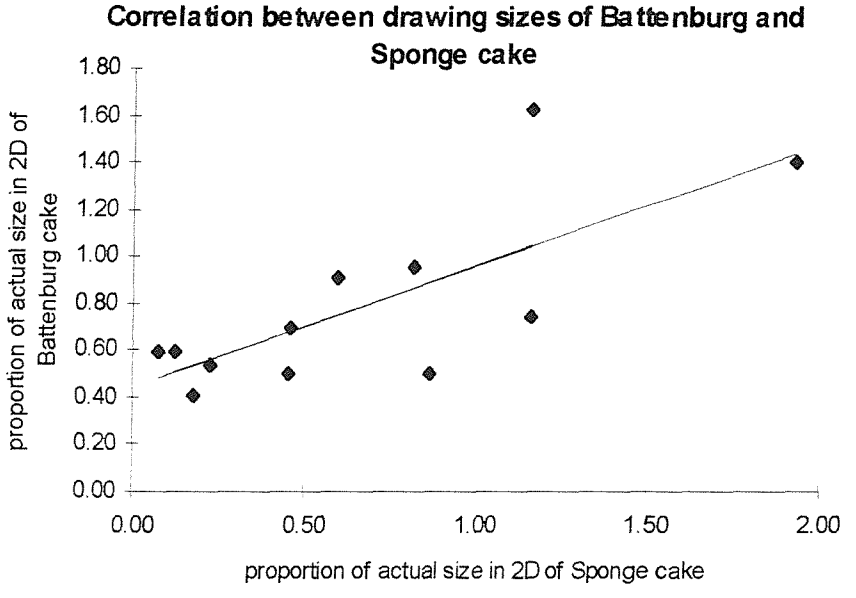
2.4.1.1.2 Results

All of the children drew pictures of the cakes that they had eaten. The majority of the children did not attempt to draw three-dimensional representations of the food. In order to establish how accurate the representations were, the area of each cake was measured and compared to the actual area of the cake on it's largest surface (5.5 x 5.5 cm for Battenburg, 6.0 x 3.5 cm for chocolate and Madeira, 6.0 x 3.0cm for coconut sponge). From drawings of the Battenburg cake it was clear that the largest surface area was the one that the children chose to draw.

Seventeen children drew a piece of Battenburg cake. The mean of the areas of the 17 drawings was 29.57cm^2 compared to the actual area of 30.25 cm^2. However, there was a wide range of drawing sizes varying in area from 40% of the true area to almost 200% of the true area for Battenburg cake and 12% to 200% for the sponge cakes. Therefore, at an individual level, drawing size did not reflect actual size.

It was hypothesised that there may be a relationship between the size of items draw within each meal that would reflect the proportion of the meal that each item of food represented. In order to test this we looked at the relationship between the dimensions of known food items, i.e. the cakes and packets of savoury snacks (measured directly from the bags recovered after the lunch time session). In children who had two different varieties of cake it was found that the correlation between the size of Battenburg cake and that of sponge cake was $R^2 = 0.57$, p=0.0048 (Pearson's correlation coefficient). See Figure 4.

Figure 4: Correlation between the drawing sizes of Battenburg and Sponge cake



The correlation was less convincing between savoury snack packets and Battenburg cake (Pearson's correlation coefficient $R^2 = 0.34$, p=0.0618). However, the numbers in both samples were small, 12 and 11 respectively.

2.4.1.1.3 Discussion

It has been found that children's drawings of 'nasty' people tend to be smaller than those of 'nice' people (Mitchell, 1992). This could also be the case with foods children like or dislike. This would bias any comparison of portion sizes derived from children's drawings. Comparing two samples of the same type of food did not allow us to test this phenomenon.

Summary findings

At an individual level, the children's drawings did not reflect the actual size of the food items eaten. There was some evidence of a correlation between the size of food items drawn by individual children but the sample size was small. Even if there were good correlations between the portions of foods eaten and the drawings, the work involved in interpreting the data makes this approach unfeasible for large-scale studies.

2.4.1.2 Identifying correct portion sizes from photographic representations: Perception

The following experiments used a set of eight ranked photographs of foods from the Photographic Atlas of Food Portion Sizes (Nelson M, Atkinson M, Meyer J. A. Ministry of Agriculture, Fisheries and Food. 1997). Each food was represented by eight photographs of incremental portion sizes. Table 12 describes the food setting and the portion weight of food used in the study. For each food the incremental weight differences between the photographs is also shown.

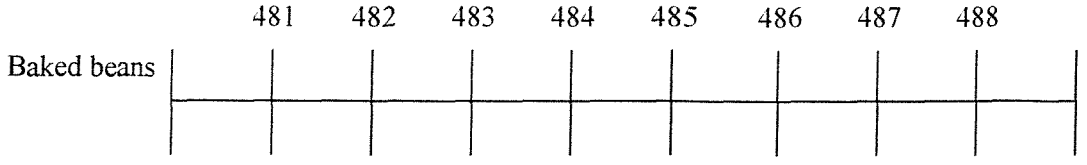
Table 12: Food item, setting and weights of foods used from the photographic portion size atlas

Food item	Setting	Portion weight (g)	Incremental weight (g)
Spaghetti	8 photos, mound on dinner plate, knife & fork	108	52.86
Cornflakes	8 photos, mound in bowl, spoon	23	7.29
Cheese	8 photos, grated, rectangle and square per dinner plate, knife and fork	25	11.71
Baked beans	8 photos, mound on dinner plate, knife and fork	134	31.43
Cabbage	8 photos, mound on dinner plate, knife and fork	96	22.29

Several exercises were undertaken to establish whether or not these could be usefully employed with prepubescent children.

2.4.1.2.1 *Method*

Fifty-four 'Y5-96' schoolchildren were asked to look at 5 plates of food and identify from a series of photographs which one was closest in portion size. To record the result the children were given a piece of paper on which was drawn a 'visual analogue scale' for each of the five foods. The line was marked at ten equal intervals. The middle eight 'tick' marks corresponded to the numbering on the photograph. The 'visual analogue scale' for baked beans is shown below.

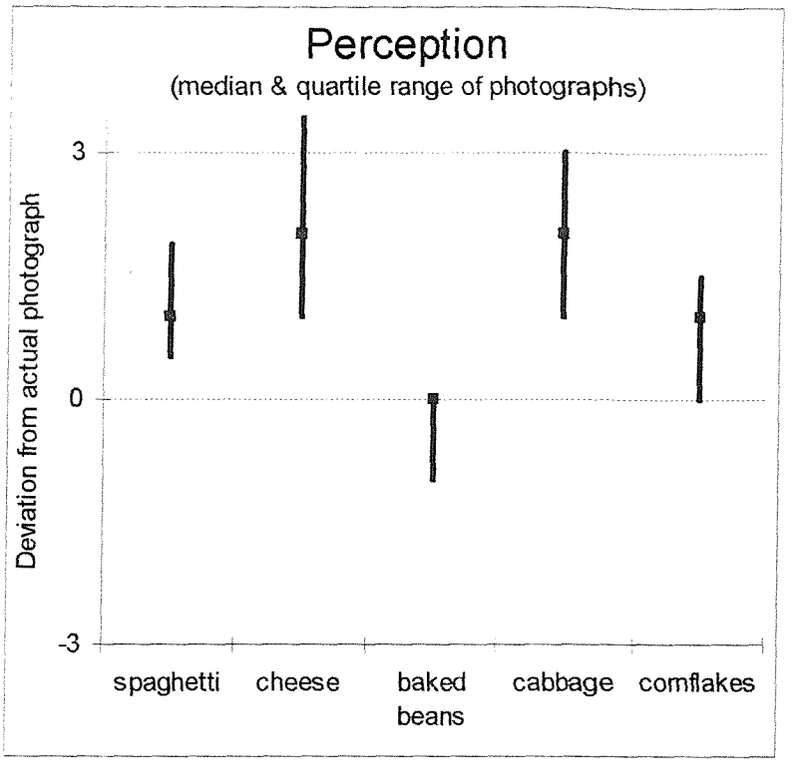


The children were asked to put a cross, anywhere along the line, at the point they thought was closest to the portion size of the food on the plates beside them. It was explained that they did not necessarily have to put a cross against any of the numbers but could put a cross anywhere between two numbers if they thought the amount on the plate was somewhere between the sizes shown in the photographs. Each child in turn viewed the plates of food and filled in their visual analogue scores out of sight of the other children.

2.4.1.2.2 *Results*

The majority of children chose to mark the visual analogue scale at a point corresponding to one of the photographs. Those who put a cross between the tick marks did so exactly mid way between the two ticks. In general, the children over-estimated the portion of food in front of them. The exception was for baked beans where the children's results had a median value equal to the portion size served. Figure 5 shows the median and quartile range, in terms of the number of portion sizes, for the five foods. For example, the median value for spaghetti was one portion size greater than the actual portion size. The median value for cheese was two portion sizes greater than the actual portion size.

Figure 5: Median and quartile range of photographic portion sizes.



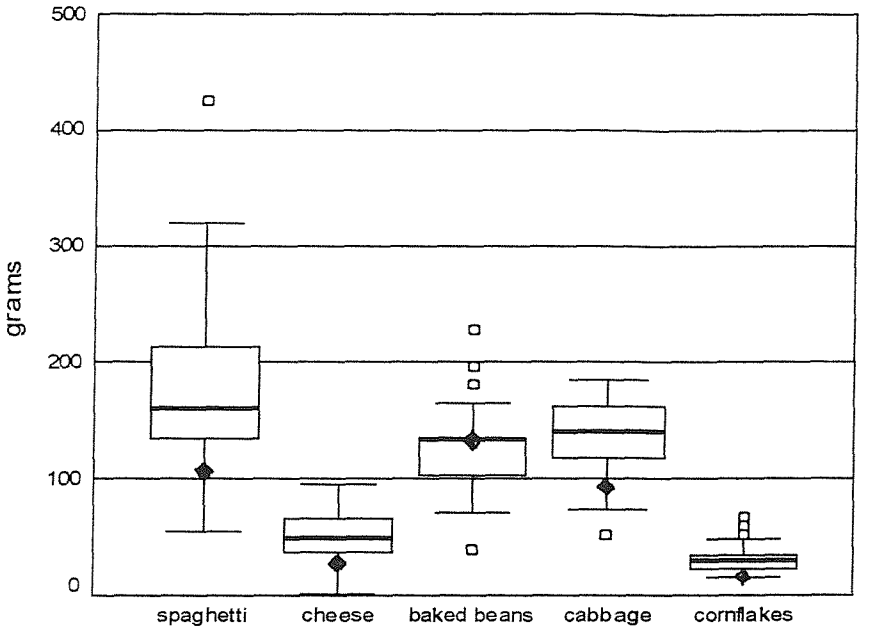
In terms of actual gram weights, Table 13 shows the absolute difference between the median weight selected by the children and the actual weight of food served.

Table 13: Actual gram differences between foods served and the median value chosen by the children

	spaghetti	cheese	baked beans	cabbage	cornflakes
Difference (g)	52.9	23.4	0	44.6	7.3

Figure 6 is a graphical representation of the actual, median and interquartile range for each of the foods displayed.

Figure 6: Children's perception of 5 different foods: actual, median and interquartile range of values by gram weights



◆ = actual weights
O = Outlier (cases with values 1.5 to 3 box lengths from the lower or upper edge of the box).

2.4.1.3 Identifying correct portion sizes from photographic representations: Conception

2.4.1.3.1 Method

Two weeks after the experiment to test the ability of children to correctly perceive portion sizes of food, a similar experiment was carried out. Forty-nine children (five children were absent) were shown the same foods and portion sizes as previously but this time before their lunch break. The foods were then cleared away and after lunch the children were given an identical visual analogue scale as in the previous experiment. They were then shown the photographs and asked to mark on the line the relative portion size for each of the foods. Again, each child did this out of view of the rest of the class.

2.4.1.3.2 Results

As with the perception experiment, the children generally overestimated the portion sizes, except for baked beans (Figure 7). Figure 8 shows the actual, median and interquartile gram weights for each of the five foods.

Figure 7: Median and quartile range of photographic portion sizes

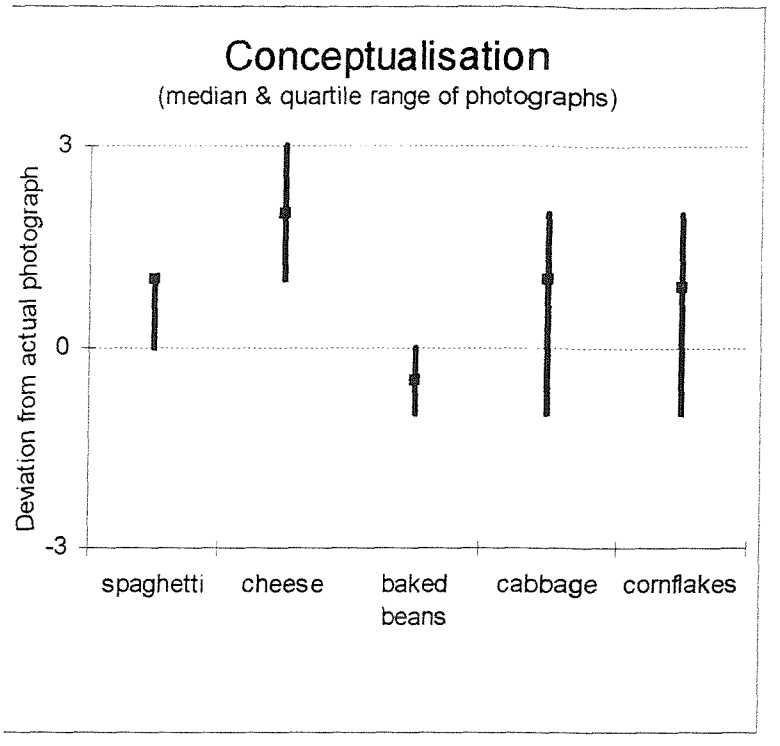
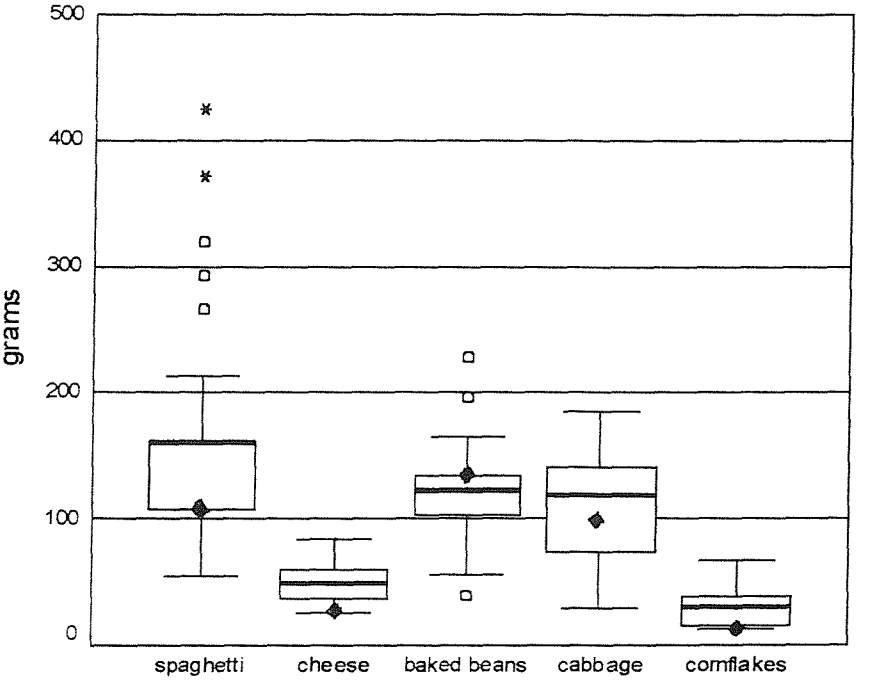


Figure 8: Children's perception of 5 different foods: actual, median and interquartile range of values by gram weights



◆ = actual weights

O = Outlier (cases with values 1.5 to 3 box lengths from the lower or upper edge of the box).

* = Extreme (cases with values > 3 box lengths from the lower or upper edge of the box).

Again, in terms of actual gram weights, Table 14 shows the absolute difference in mean weights. The results were similar to those for the perception experiment but in each case the difference between the mean and actual weight was less.

Table 14: Actual gram differences between foods served and the median value chosen by the children

	spaghetti	cheese	baked beans	cabbage	cornflakes
Difference (g)	52.9	23.4	-15.7	22.3	6.4

Looking at the actual percentage difference by weight between the mean values and true weights of foods served; they ranged from –11.7% for conceptualisation of baked beans, to +93.7% for both the perception and conceptualisation of the portion size for cheese (Table 15).

Table 15: The percentage, by weight, above or below the actual weight of food served

	spaghetti (%)	cheese (%)	baked beans (%)	cabbage (%)	cornflakes (%)
Perception	48.9	93.7	0	46.4	31.7
Conception	48.9	93.7	-11.7	23.2	27.7

2.4.1.3.3 Discussion

The children tended, on average, to overestimate portion sizes of food whether or not the food was in front of them. Robinson *et al.* used portion size photographs in a study of 100 adult and found that the mean estimation of portion weight of mashed potatoes and cornflakes were reasonable (+7.7% and –2.1% respectively) (Robinson *et al.*, 1997). However, the individual variation was wide; mashed potatoes ranged from –70.6% to +198.7%, cornflakes ranged from –23.9% to +50.0%. In this study the overestimated mean of cornflakes by 35.6% which ranged from –31.7% to +190.2%. In an Italian study by Faggiano *et al.*, 103 adult volunteers were asked to recall the portion sizes of foods they had eaten at lunch

the day before from a selection of seven different photographs (Faggiano *et al.*, 1992). The volunteers had been invited to a restaurant the previous day where the foods they ate had been weighed. No gender or age differences were found in the ability to estimate portion sizes. The researchers found an overestimation of pasta, green salad, soup, meat and cheese. Cheese was overestimated by 50-95%. In this study, the children's perception of a portion of cheese overestimated the portion weight by, on average, 104% with a range of –93.7% to 281.0%.

The wide variation in portion size estimates by prepubescent children shows that the use of individual portion size data would be meaningless. If we are simply interested in allocating food by food groups, then the actual portion size may not be of importance in reflecting the balance of the diet.

Another issue of importance is the ability of children to use photographs of similar foods to identify portion sizes, when photographs of the actual food was not available. There was circumstantial evidence that children found it difficult to substitute alternative foods when making decisions about portion sizes. The children in this study had used a set of food photographs to describe their lunch. In a number of cases, where the children could not find the exact food, they failed to report the food. This has implications for the under-reporting of foods not simply under- or over-reporting of portion sizes.

Summary findings

At the group level, there was little difference between the children's perception and conceptualisation skills. In general, the children overestimated portion sizes.

At an individual level, the wide variation in reported portion sizes indicates that children of this age have difficulty identifying portion sizes from small photographs.

If identification of portion size is important in allocating foods to food groups than it may be sufficient for children to indicate between three options, large, medium and small. This requires further research to determine if this is a feasible option.

2.4.1.4 Identifying correct portion sizes from computer images

It was hypothesised that children found it difficult to relate the actual portion sizes of foods displayed in front of them to small photographic images. Therefore, in order to see if the use of actual size images of foods could help children relay information about portion size, a series of eight ranked photographs of portions of pasta were scanned into a computer and enlarged to actual size. The individual portion sizes could then be viewed on the computer screen one at a time.

2.4.1.4.1 Method

Fifty-five children (Dataset 3) were asked individually, to choose the image that they considered was closest in size to the amount of pasta served up on the plate beside them. The portion sizes depicted by the computer images ranged from 55g to 425g with equal increments of 52.86g. The portion weight on display was 161g.

Two classes took part in the in the experiment, class A (12 girls, 15 boys) and class B (15 girls, 13 boys). The children were shown how to change from one picture to the next by using the mouse to click on the up or down buttons on the screen. They were told firstly, to go right through the sequence of pictures, then to go to the one they thought was most representative of the plate of pasta in front of them. Once they had viewed all the pictures they were free to scan through them as often as they wished until they were satisfied with the one they had chosen.

The two classes viewed the sequence of pictures in different orders, class A going from the smallest portion to the largest, and class B going from largest to smallest.

2.4.1.4.2 Results

The majority of the children (49%) overestimated by one portion size and a further 36% by two portion sizes. Only 4 children (7%) actually chose the correct portion size. There was no difference between the median value for girls and boys. However, there was a difference between the two classes. The median value for class A (low to high sequence) was one portion size larger than the pasta displayed, where as the median value for class B (high to low sequence) was two portion sizes greater. In terms of the mean weight class A had a mean weight of 231g (43.7% above actual weight) and class B, 244g (51.4% above actual value).

These values were not significantly different but the sample size was relatively small.

2.4.1.4.3 Discussion

Compared to the perceptual test using the small photographs, the range of values chosen by the children was narrower with the lower quartile equal to the median and the upper quartile one increment above. The percentage weight above the true weight was smaller than when the children used the small photographs. It should be noted that the children did not have the opportunity to choose a value between two computer images. This deserves further investigation.

The difference in the median choice of portion size depending on whether the children viewed the largest portion size first or the smallest (or visa versa) was not significant. As the number of children in each arm of the experiment was relatively small it would be worthwhile investigating this phenomenon further in a larger group.

Summary findings

Using life sized computer images of food children lead to an overestimation of the portion size, although the spread of sizes chosen was narrower than using small photographs. The order of viewing the images (largest to smallest or visa versa) did not appear to make a difference. However, the sample size was relatively small and it would be worth further investigations in a larger population with a wider range of foods.

Further investigations in a larger population are required to establish whether allowing the children to identify intermediate portion sizes improves their estimation.

2.5 Chapter summary

The discussion group work carried out during the preliminary stages of the investigation provided background information about foods typically eaten by this population of prepubescent children. These data were used firstly as the foundation for the food-based database (see Chapter 3), and secondly to find the most practical way for children to record dietary information. Discussion group work with children indicated that an appropriate method to record information was by meal and snack periods.

Although analysis of a single meal does not provide information about the total diet, observation of school lunch provided the opportunity to obtain group data on usual lunch practice and to identify any rudimentary problems with the allocation of foods into food groups. Information gathered during the preliminary stages was used to construct the initial food group database.

At an individual level, children's drawings did not reflect the actual portion size of foods eaten. There was some evidence of proportionality between the foods individual children drew but the numbers in the study were small. Even if there proved to be good correlations between food items drawn the difficulties with interpretation and analysis of drawings in a large-scale study makes this method unrealistic.

When using a series of small photographs of foods to identify portion sizes children generally overestimated the amount of food. This was the case whether or not the food was in front of them at the time. There was wide variation in portion sizes chosen which indicates that prepubescent children have difficulties using small food photographs to identify portion sizes. The use of life-sized computer images of the food led to less variation in the selection of portion sizes among the children. There was a non-significant difference between the children viewing the portions from largest to smallest compared to those viewing the images in the reverse order. However, the study sample size was relatively small and further investigations are needed to identify if there is a genuine difference in selection of portion sizes dependent on the order the images are viewed.

Overall, it would appear that prepubescent children have difficulty identifying portion sizes. The use of life-sized computer images seemed to produce the best

results but this would be an expensive and time-consuming method of data collection. With such individual variations it is unclear whether or not the amount of time and effort involved in collecting portion size details would enhance the results from the food group database. Therefore, a food group database has been developed without recourse to portion size information from children.

3 Food Group Database

Objective

3. i) To determine the feasibility of describing nutrition information in terms of food groups.

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In order to analyse data in terms of food groups it is necessary to establish a food group database. Based on the underlying principles of the 'Balance of Good Health' guidelines, this chapter describes the development of a food group database to be used in conjunction with the assessment tools developed within this project. Section 3.2 describes the development of a database using the same assumptions as used to create the 'Balance of Good Health' guidelines. The third section (3.3) compares actual weights to standard portion sizes. Section 3.4 looks at the development of a simplified version of the food group database for use in the classroom setting, using a small sample of prepubescent children to compare standard portion weights with actual weights consumed. Section 3.5 summarises the chapter.

3.1 Introduction

Throughout this thesis, the 'Balance of Good Health' plate has been represented by a pie chart. During preliminary work, information portrayed in the form of a pie chart was found to be readily understood by prepubescent children. When conducting the fieldwork, the 'Balance of Good Health' pie charts were illustrated in colour for ease of recognition by the children. The cereals group was red, the fruit and vegetable group green, meat, fish and alternatives pink, milk and milk products blue, fatty and sugary group yellow. These colours are consistent with the 'Balance of Good Health' plate used during nutrition education.

3.2 Standardised Food Group Database

The 'Balance of Good Health' guidelines were not intended to be used as a method for dietary assessment or analysis of nutrition knowledge but as a tool to promote healthy eating. However, if we are to use an analytical approach to assessing dietary behaviour and knowledge based on food groups, then it may be appropriate to use a similar structure. Evidence from the preliminary work would suggest that, because of the wide variation in the perception and conceptualisation of portion sizes by prepubescent children, portion size data obtained from this age group may not be particularly accurate, (see section 2.4). Therefore, it was decided that the development of a food group database would not rely on portion size data derived from the children.

Based on the assumption that prepubescent children have proportionally similar food intakes to adults, regardless of energy requirements, the following food database was devised.

Using the same criteria as that of the 'Balance of Good Health' guidelines (section 1.7.1.2), a computerised database was established of commonly eaten foods. The list of foods was derived using information obtained during the preliminary stages of this research. Foods listed were generic rather than specific, e.g. 'savoury snacks' included crisps, puffed rice products, potato rings etc., 'sweets' made no distinction between chocolate, boiled sweets, chocolate-coated bars etc. Additional foods were added as necessary. Miscellaneous foods such as pickles, sauces and tea were excluded. Non-diet soft drinks were included as their sugar equivalent. The volume of milk and fruit juice was halved.

Foods were allocated to one of the five 'Balance of Good Health' food groups using standardised portion weights (Ministry of Agriculture Food and Fisheries, 1993). Combination foods were proportionally allocated to two or more food groups.

3.3 Comparison of Standardised Food Group Database with Actual Weights

The validity of a dietary assessment method is its ability to measure actual food intake. As previously discussed (section 1.7.4), it is not possible to measure 'true' diet and we must rely on measures that will give the best estimate of the truth. Weighed records are most commonly used as the standard against which other dietary assessment tools are calibrated. To assess the relative validity of the standardised food group to measure dietary intake, standardised food group data from a set of 4-day weighed records (Dataset 4) was compared with actual values. See Chapter 5, Section 5.5.1 for full details on the methods used to collect the weighed record data.

3.3.1 Method

In order to test whether the database could be used to measure the dietary behaviour of prepubescent children, twenty 4-day weighed records were collected from a group of 'Y5-96' children. The twenty weighed records were analysed by food group using the criteria established for the 'Balance of Good Health' guidelines outlined above and compared to the actual mean daily intake in grams.

3.3.2 Results

Table 16 shows actual compared to standardised mean weights by food group.

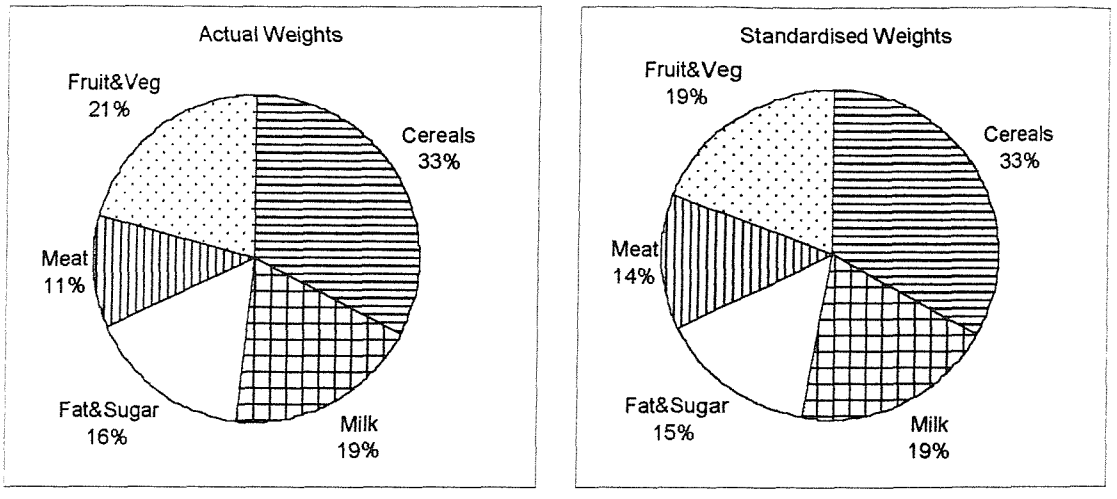
Table 16: Average daily intake of food by food group: actual compared to standardised weights

	Actual weights (g)		Standard weights (g)		t-test
	Mean	SD	Mean	SD	p value
Bread, cereals and potatoes	322	69	332	88	0.62
Fruit and vegetables	207	119	192	86	0.32
Milk and milk products	189	83	196	82	0.48
Meat, fish and alternatives	108	36	135	27	<0.001
Fatty and sugary foods	163	88	148	60	0.19

The only statistical difference between the actual weights and standardised weights by food group was in the meat, fish and alternatives group ($p<0.001$).

Figure 9 shows the percentage of foods by food group for actual and standardised weights.

Figure 9: Percentage of foods by food group; actual compared to standardised weights



The children were divided into above or below average consumption for each of the food groups and the results for the actual and standardised weights compared (Table 17).

Table 17: Average daily intake of food by food group: percentage of children correctly classified as above or below the average intake

	% correctly classified as high/low intake
Bread, cereals and potatoes	50
Fruit and vegetables	90
Milk and milk products	90
Meat, fish and alternatives	80
Fatty and sugary foods	80

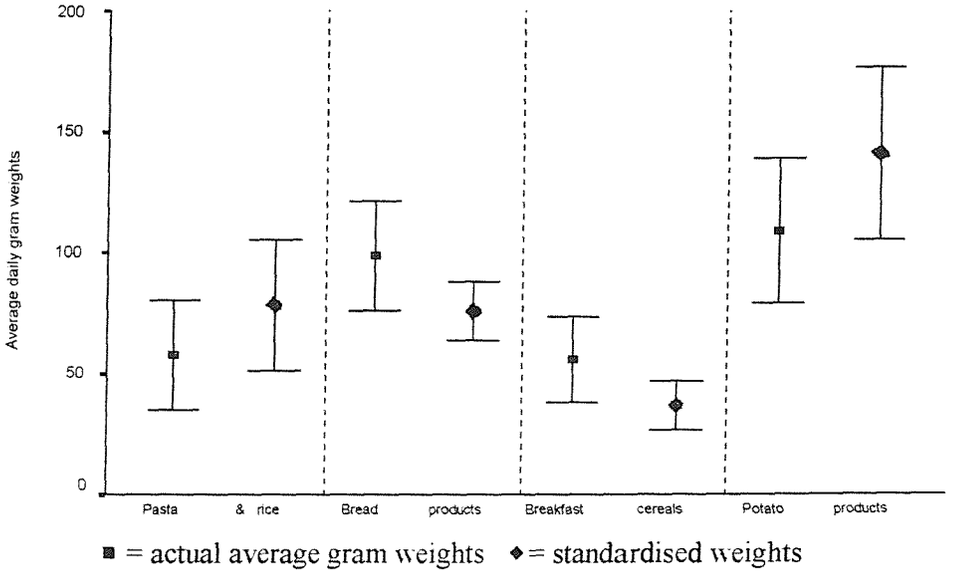
As can be seen from Table 18 standard weights classified eighty percent or more of the children correctly for all the food groups except bread, cereals and potatoes. Half of the children were misclassified for the bread, cereals and potatoes group. Breaking the bread, cereals and potatoes group down into the different food types (pasta and rice, bread, breakfast cereals, potatoes) showed a significant difference between the actual and standardised weights.

Table 18: Average daily intake of bread, cereals and potatoes by food types: actual compared to standardised weights

	Actual weights (g)		Standard weights (g)		t-test	% correctly classified
	Mean	SD	Mean	SD	p value	
Pasta and rice	68	45	92	51	0.009	90
Bread and bread products	99	48	76	26	0.02	80
Breakfast cereals	62	35	41	18	0.001	89
Potato and potato products	109	65	141	76	0.03	70

However, as can be seen from Figure 10, the differences were not all in the same direction. Actual pasta, rice and potato consumption was less than estimated using standard weights, whereas bread and breakfasts cereals were consumed in greater quantities than estimated by standard servings.

Figure 10: Mean and 95% c.i. for actual and standardised weights of pasta and rice, breads, breakfast cereals and potato products



3.3.3 Discussion

At the population level there were no significant differences between the actual mean weights and standardised mean weights for any of the food groups except the meat, fish and alternatives group. The actual average daily intake of meat, fish or alternatives consumed was significantly less than the mean weight calculated using standardised weights (108g compared to 135g). The National Diet and Nutrition Survey (Office for National Statistics (Social Survey Division), 2000) found that 7-10 year olds consumed, on average, 126g of meat, fish or baked beans (other pulses not included) per day. This implies that further research may be required to establish appropriate standardised weights for meat, fish and alternatives for 9 to 10 year olds.

Categorising the children into above and below average consumption by food groups showed that there was poor classification for the bread, cereals and potatoes group. Classification was improved when the bread, cereals and potatoes group was broken down into similar food types. It would appear that children of this age group consume greater quantities of bread and breakfast cereals than the population standard and smaller quantities of pasta, rice and potato products. The National Diet and Nutrition Survey (Office for National Statistics (Social Survey Division), 2000) found that the actual weights for bread and bread products for all children (including non-consumers) was 73g/day but this did not include current buns or teacakes which were included in this study. It also found that the actual weight of pasta and rice (excluding rice pudding) was 43g/day, potato and potato products 95g/day. However, they found that the average consumption of breakfast cereal was 31g/day, half that of this study.

Evidence from this pilot study indicates that the use of standardised food weights based on adult data overestimates the consumption of meat, fish and alternatives and is insufficient to correctly categorise prepubescent children for bread, cereals and potatoes. Further information from a larger population of prepubescent children is needed in order to establish more accurate standardised weights if this tool is to be used to classify children into sub-groups.

The standardised food group database has two potential limitations for use within the classroom setting. Firstly it relies on computing facilities, this is a feasible option for use as a research tool but it may not be possible within schools. Secondly, the use of food specific standardised weights requires children to be able to differentiate between certain food types. For example, it may not be sufficient for children to report eating breakfast cereal, as the standard serving size for muesli, for instance, is more than twice that of puffed rice. The next step, therefore, was to look at a simplification of the method for use in the classroom and the effect of simple allocation of foods to the relevant food groups.

3.4 A Simple Food Group Database for use in the Classroom

One of the aims of this research was to provide a tool capable of monitoring the dietary knowledge and behaviour of prepubescent children in the classroom setting. If we wish to devise a simple analytical tool for use in schools it will be necessary to provide a database which can be used without the employing computers. Therefore the next stage of the project was to create a simple, food group database for use as a dietary analysis tool to measure the diet of prepubescent children. The remit was to produce an analysis tool capable of measuring knowledge and behaviour in terms of foods.

3.4.1 Method

Using 'portions' to describe a food eaten at a single occasion, the twenty weighed records were reanalysed. The following assumptions have been used in the derivation of the simplified food group database (Table 19).

Table 19: Basic assumptions for allocating foods to 'Balance of Good Health' food groups

- *Any mention of a food as part of a meal or a snack was taken as one portion. For example, if one child mentioned that they had eaten two potatoes and another stated that they had eaten four, both children would still only score one portion in the bread, cereals and potatoes group.*
- *It was assumed that every time a food was mentioned, all of it was eaten.*
- *Composite dishes were allocated to the group that contained its main constituent part, unless it was obvious that it had two or three main components. For example, spaghetti bolognese or lasagne was coded as a portion of meat (or vegetable) and a portion of pasta (cereals group); pizza was coded as a portion of bread, half of a portion of vegetable and half of a portion of cheese (milk group).*
- *Where breakfast cereals were mentioned, a portion of milk was also recorded.*
- *For tea or coffee, a third of a portion of milk was recorded.*
- *Sugar in tea or coffee or on breakfast cereal was recorded as a fifth of a portion.*
- *Sandwiches and toast were assumed to be one portion of bread; no account was taken of the number of slices of bread used.*
- *Fat spreads and sweet fillings or toppings for sandwiches, toast or bread were taken to be a fifth of a portion.*

The allocation of milk was based on the average glass of milk (approximately a third of a pint). It was assumed that children had the equivalent of a whole glass of milk with breakfast cereals. For tea and coffee, it was assumed that children would have the equivalent to a third of a glass of milk in their drinks.

All breakfast cereals were allocated as a portion in the bread, cereal and potatoes food group taking no account of differing sugar content. Sugar added to breakfast cereals was taken as a fifth of a portion. Sugar added to tea or coffee was assumed to be a similar amount to that used on cereal, therefore this was also taken to be a fifth of a portion. As a portion of jam has a similar sugar content equivalent to1 or 2 teaspoons of sugar, this was likewise treated as a fifth of a portion in the fatty and sugary foods group.

Having assumed a fifth of a portion for sweet fillings and toppings for sandwiches, toast or bread then it would be reasonable to take the same value for fat spreads. No differentiation was made for the different energy values of different fat spreads. To keep the methodology simple, it was decided that restricting the divisions of portions to a half, a third, a quarter and a fifth was sufficiently accurate for the purposes for which the tool was intended.

The weighed records were reanalysed using the simple food group database and the resulting standardised portions were compared to actual weights.

3.4.2 Results

Reanalysing the weighed records using the simple food database gave the following results (Table 20).

Table 20: Percentage by food group: actual weights compared to simple portions

	Actual weights (%)		Simple portions (%)		t-test
	Mean	SD	Mean	SD	p value
Bread, cereals and potatoes	32.8	5.9	27.8	4.7	0.001
Fruit and vegetables	20.6	11.1	18.7	7.5	0.12
Milk and milk products	19.1	7.8	18.8	6.5	0.78
Meat, fish and alternatives	11.1	3.8	11.6	4.1	0.51
Fatty and sugary foods	16.5	8.0	23.2	9.4	<0.001

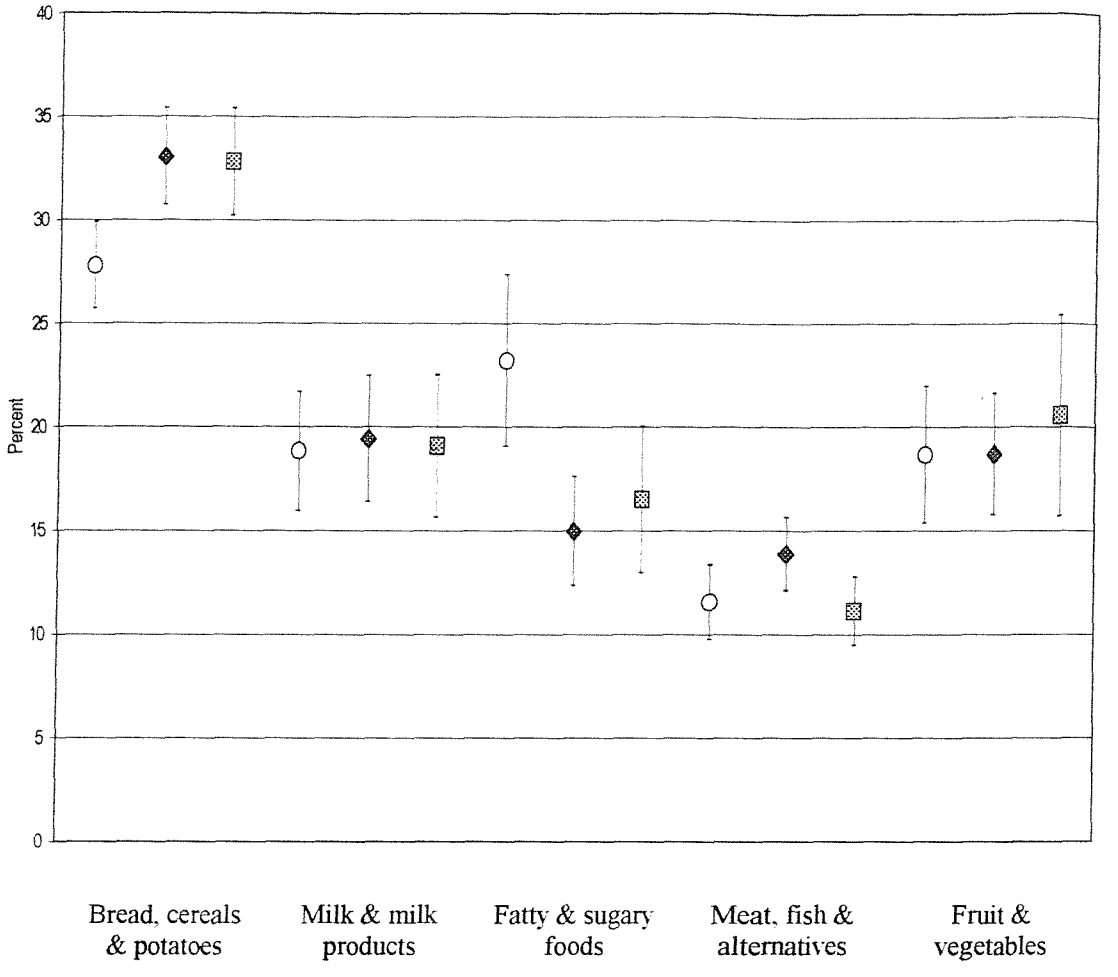
Table 21 shows the comparison of actual intake with simple portion when the children were divided into above and below average consumption. Allocation of food intake by simple portions categorised eighty percent or more of the children correctly for all the food groups except bread, cereals and potatoes. Once again, breaking the bread, cereals and potatoes group down into the different food types improved the categorisation of the children for all the food types. The correct classifications ranged from 70% for potato and potato products to 95% for pasta and rice.

Table 21: Percentage of children correctly classified as above or below the average intake comparing actual intake with simple portions

	% correctly classified as high/low intake
Bread, cereals and potatoes	60
Fruit and vegetables	80
Milk and milk products	90
Meat, fish and alternatives	80
Fatty and sugary foods	90

Figure 11 shows the comparison of the three methods of analysis, actual weights, standard weights and standard portions. The mean and 95% confidence interval for each of the methods is displayed by food group.

Figure 11: Mean and 95% confidence interval of the percentages by food group for simple portions (○), standard weights (◆) and actual weights (▣).



3.4.3 Discussion

As can be seen from Table 20 there were significant differences between the actual mean weights and the simple portions for the bread, cereals and potatoes group and the fatty and sugary foods group. The use of simple portions underestimates the proportion of the diet attained from bread, cereals and potatoes and overestimates the proportion from fatty and sugary foods. However, as an educational tool the resulting data serves to highlight the under consumption of fruit and vegetables and the over consumption of fatty and sugary foods. Therefore it would be reasonable to use the simplified food group database in the

classroom setting as part of the evaluation of nutrition knowledge and current dietary behaviours.

Classification of children into above and below average consumption gave similar result to that of standard weights. However, the study population was small and future work will look at the ability of the simple portion database to classify intake in a larger group.

For the purposes of analysis of children's dietary patterns and nutritional knowledge with the tools developed in this project, the simplified version of the food database will be used. Future work to refine standard food portion sizes for prepubescent children will provide data to improve the standardised food group database for use as a research tool.

Summary finding

Although the use of the simplified version of the food group database underestimates the consumption of bread, cereals and potatoes and overestimates the consumption of fatty and sugary foods, it provides a simple, easy to use method for assessing dietary patterns and nutrition knowledge in prepubescent children.

The simplified food group database correctly categorises the majority of the children into above or below average consumption in a similar manner to the standard weights database.

Further research is required to look at standard food portion sizes for prepubescent children.

3.5 Chapter Summary

This pilot work indicates that the use of the standardised food weights used to establish the food group proportions of the 'Balance of Good Health' overestimates meat, fish and alternatives and does not correctly categorise prepubescent children with respect to bread, cereals and potatoes. If this method is to be used as the basis of a food group database then further work is required to establish standardised food weights for this age group.

Using the simplified version of the food group database underestimates the proportion of bread, cereals and potatoes and overestimates the proportion of fatty and sugary foods. However, as an educational tool the message it conveys is consistent with that of the 'Balance of Good Health' principles.

The simple food database has been used in the analysis of the data collected for the development of the dietary assessment and nutrition education tools.

4 Development of Appropriate Nutrition Knowledge Assessment and Education Tools

Objective

4. i) To identify and develop appropriate methods to allow children to communicate their nutritional knowledge.

   ii) To assess the nutritional knowledge of prepubescent children.

   iii) To measure change in knowledge following nutrition education.

   iv) To use the 'Balance of Good Health' guidelines as a basis for enhanced nutrition teaching tools.

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This chapter looks at the development of nutrition knowledge assessment and education tools suitable for prepubescent children. The assessment tools were designed to collect and present data in terms of food groups using the simple food group database described in Chapter 3 for the underlying analysis.

Nutrition education is part of the normal curriculum at the study school. The development of the nutrition education tools were designed to enhance the 'Balance of Good Health' material used in the classroom.

The nutrition assessment and education studies were divided into three stages. Firstly, preliminary work was conducted to establish an appropriate means for prepubescent children to communicate their nutritional knowledge (section 4.2). Secondly, the developmental work looked at tools to determine the knowledge of the children. This included the use of pre- and post-nutrition education assessments, and a food group allocation exercise (section 4.3). Thirdly, the development of two nutrition education tools designed to enhance the 'Balance of Good Health' guidelines (section 4.5). A summary of the chapter is given in section 4.6

4.1 Introduction

The Government has chosen to use the 'Balance of Good Health' plate as a vehicle to disseminate the message of eating a healthy and balanced diet (Department of Health, 1994c). Although this campaign may be useful for adults it has not been proven as an effective means of communicating the information to children. The following chapter explores the use of the 'Balance of Good Health' guidelines for educating prepubescent children and examines ways to enhance their effectiveness. The provision of nutrition education is not enough in itself; it is also necessary to ensure that the nutrition messages are received correctly. A study of 7 to 10-year-olds found that children were aware of fat being a part of food, and were aware of its possible ill-effect on health, but that they were unaware of the relative fat content of foods (Sherratt, 1996). Measuring individual and group knowledge using assessment tools may allow for more specific targeting of nutrition education. For example, if children only consider fruit and vegetable as 'healthy' foods, then educators can reinforce the idea of a balanced diet being healthy. Follow-up sessions would allow for monitoring of progress. In addition, feedback at a national level will enhance the overall National Curriculum nutrition education programme.

Following the establishment of the government food group initiative, use of the 'Balance of Good Health' guidelines was considered appropriate as central to any nutrition education exercise. It was also felt appropriate to use them as a basis for the analysis of nutritional assessment tools, particularly since one of the aims of the guidelines is to "provide a foundation for the development of educational materials for use in different settings". The major advantage of the guidelines is that they relate to foods and not nutrients. For prepubescent children, the concept of nutrients is likely to be difficult to understand. Therefore, the food-based 'Balance of Good Health' guidelines provide a good platform from which to develop nutrition education for children.

4.2 Preliminary Studies

4.2.1 Draw and Write

The concept of a 'healthy balanced meal' was used as the basis for assessing the ability of 9 to 10-year-olds to convey nutritional information and to see if it was a useful means to assess change in knowledge. Two draw and write exercises were undertaken, one before and the other after a two week nutrition and health education course which was part of the school curriculum.

4.2.1.1 Method

The 'Y5-95' class of thirty-one 9 to10-year-olds (Dataset 5) were asked to draw their perception of a 'healthy balanced' meal and to label the foods. It was explained to them that there was no such thing as 'bad' foods and that there were no right or wrong answers. They were also asked to comment on why they thought what they had drawn was a healthy balanced meal.

At the first draw and write session the children were also asked to draw what they considered to be an 'unhealthy, unbalanced meal'. After they had completed the drawing they were asked to write down why they considered the meal they had drawn to be an 'unhealthy, unbalanced meal' and how they thought they could make their meal into a healthier, more balanced option.

Over the following fortnight they had a series of lessons on nutrition and health. The nutrition information was in line with the Health Education Authority's 'Balance of Good Health' programme. At the end of the two weeks the children were again asked to draw their impression of a 'healthy balanced meal'.

4.2.1.2 Results of 'Healthy, Balanced Meal' Drawings

The results were analysed using the simple food group database. A portion of food was allocated to the appropriate food group every time it was drawn, regardless of the size of the portion. The pre- and post-nutrition education proportions by food group are shown in Table 22 below.

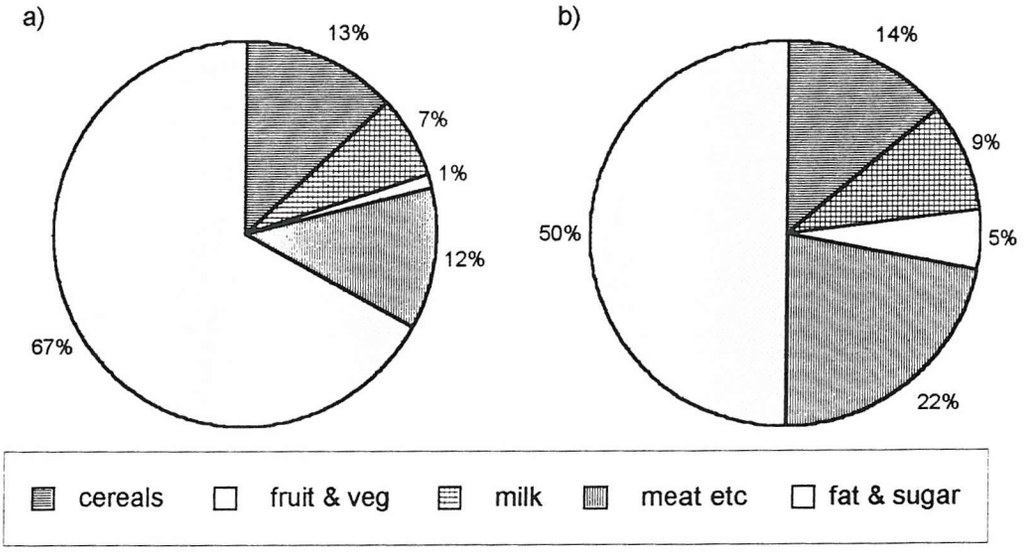
Table 22: Food groups drawn as part of a 'healthy balanced' meal before and after nutrition education.

Food Group	1st session	2nd session
Fruit and vegetables	67%	50%
Bread, other cereals and potatoes	13%	14%
Milk and dairy produce	7%	9%
Meat, fish and alternatives	12%	22%
Fatty and sugary foods	1%	5%

The results of the children's 'healthy, balanced meals' are shown in the form of 'Balance of Good Health' pie charts (Figure 12). In both the pre- and the post-education drawings the children considered fruit and vegetables to be the most significant part of a 'healthy balanced meal'.

Figure 12: 'Healthy Balanced Meal' percent of foods by food group:

a) Before nutrition education, b) after nutrition education



Post-education drawings had fewer items in the fruit and vegetable group and more in each of the other four food groups compared to pre-education. Pre-nutrition education, the children drew a total of 245 food items (an average of 7.9 food items each), of which two-thirds were fruit and vegetables. Post-education,

the total number of items recorded was 169 (approximately 5.5 items per child) but again fruit and vegetables were high on their list of 'healthy' foods (Table 23). Using a χ^2 test for the group as a whole, there was a significant difference in the number of portions the children drew pre- and post-nutrition education ($\chi^2 = 13.45, p < 0.01$). There was a significant difference in the number of fruit and vegetables drawn pre- and post-nutrition education ($\chi^2 = 11.18, p < 0.001$). Excluding fruit and vegetables, there were no other significant differences in the number of portions drawn pre- and post-nutrition education.

Table 23: Number of food items drawn pre- and post-nutrition education

Food group	Pre-nutrition education		Post-nutrition education	
	Total number	Ave/child	Total number	Ave/child
Bread, cereals and potatoes	33	1.4	24	1.0
Fruit and vegetables	162*	7.0	84*	3.7
Milk and dairy products	17	0.7	16	0.7
Meat, fish and alternatives	30	1.3	37	1.6
Fatty and sugary foods	3	0.1	8	0.3
Total number of foods	*245***	*10.7*	*169***	*7.3*

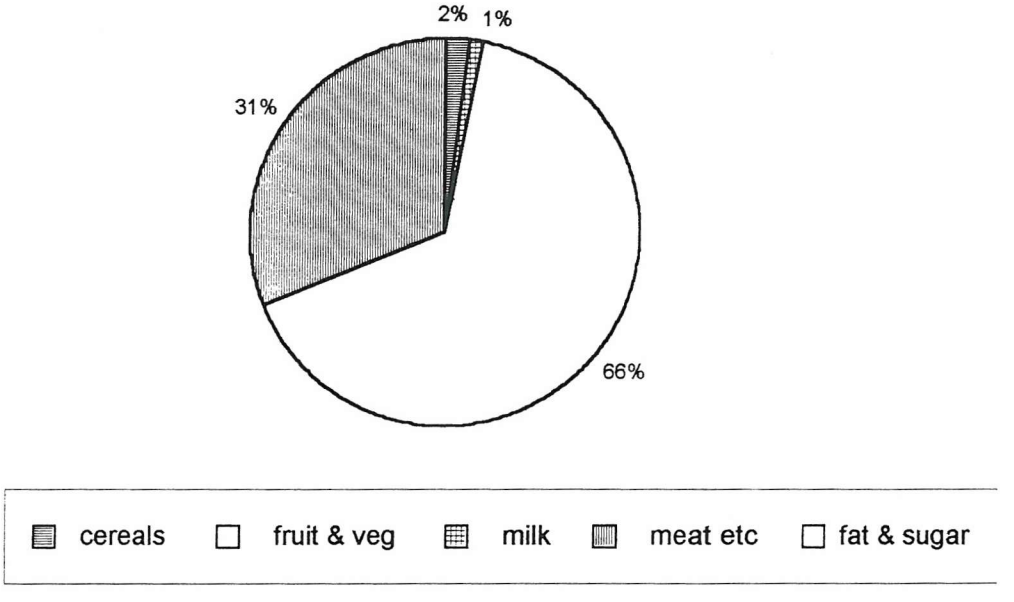
* $\chi^2 = 11.18, p < 0.001$; ** $\chi^2 = 13.45, p < 0.01$

At the first drawing session prior to the fortnight of nutrition education, the children were asked to say why they thought the meal they had drawn was a 'healthy' meal. Many of the children focused on 'healthy' being high in vitamins. Responses included, for example, "there is a lot of vitamin C in the fruit", "this meal is healthy because they all have vitamins and iron in them" and "vegetables and fruit are extremely healthy because some people like sailors get scurvy". The children were also concerned about fat and sugar, some of them stating that the meal they had drawn was healthy because "...the meat has no fat on it", "...they have low calories and contain little sugar" and "...it is not fried". Other concepts included "an apple cleans your teeth", "the vegetables (drawn) are organic, not tinned", as well as some interesting interpretations of current scientific opinions; - "vegetables stop cancer", "beefburgers give you mad cows disease".

4.2.1.3 Result of 'Unhealthy, Unbalanced Meal' Drawings

The results from the drawings of an 'unhealthy, unbalanced' meal are shown below in Figure 13 in the form of the 'Balance of Good Health' pie chart. Most of the children drew foods such as burgers, fried eggs, chips, tomato sauce, ice-cream and coke. Clearly, the children are well aware of the types of foods that should not be eaten in excess. In total, the children drew 180 food items, 120 of which were from the fatty and sugary group (an average of more than 5 per child). Fifty-five items (mainly sausages and beefburgers) were from the meat, fish and alternatives group, an average of 2.4 items per child.

Figure 13: Percentage of food items by food groups from the drawings of an 'unhealthy, unbalanced' meal



The children's comments on why the meal was unhealthy and unbalanced were along the lines of "(the meal has) got too much fat", "sugar is bad for you because it rots your teeth away", "(the meal has) too much salt". Some of the pupils seem to have advanced nutritional knowledge ("salt gives you high blood pressure", "coke has caffeine in it"), but it is uncertain if they understand the concepts behind the knowledge. Others were less well-informed: "if you eat too much sugar you could get worms", "coke is not healthy because it is so gassy", "if you have too much salt it clogs up your insides".

The majority of the children recognised that they could improve the meal they had drawn by not frying foods, by making low calorie food choices and by replacing cakes or ice-cream with fruit. However, some of the children felt that the only option was to eat less rather than substituting other foods or cooking methods. All the comments were given to the class teacher on an anonymous basis.

4.2.1.4 Discussion

The results indicate that the nutrition information given to the children during the fortnight altered their perception of a 'healthy, balanced meal'. However, by comparison to the 'Balance of Good Health' guidelines, the children still tended to over-represent fruit and vegetables and to under-represent bread, cereals and potatoes, and milk and milk products. Fruit and vegetables, particularly apples, carrots and salad vegetables, were seen as healthy options. Even after the nutrition fortnight, 50% of the items drawn were from the fruit and vegetables group. The inclusion of fatty or sugary foods was limited; both before and after nutrition education, children perceived that these foods as 'unhealthy'.

From the average number of portions of food that the children drew post-nutrition education, it can be seen that they were more realistic in the quantities of food comprising a healthy balanced meal (Table 23). However, in both the pre- and post-education drawings there was a greater emphasis on including fruit and vegetables in the diet and less emphasis on starchy foods. This is clearly illustrated in the 'Balance of Good Health' pie charts, with fruit and vegetables representing two-thirds of the pre-education chart and half the post-education chart (Figure 13).

One of the advantages of getting the children to draw the meals was that many of the children provided more detail about brands of foods and types of food which were not reflected in listing alone. For example, children would draw a can of diet lemonade but simply label it "lemonade". Since diet lemonade was excluded from the analysis (as it has little nutrient value) whereas ordinary lemonade was allocated as a portion in the fat and sugar group, this made a difference to the balance of their food groups. In addition, some children had difficulty spelling, so the drawings helped the researcher to identify the foods.

Comparison of the pictorial representations of the 'healthy' and 'unhealthy' meals illustrated graphically the children's knowledge. The pie charts revealed that the overall balance for the meal drawn by the children was not similar to the 'Balance of Good Health' guidelines. The pie chart produced prior to nutrition education would be a useful starting point for teachers to discuss the principle of a 'healthy, balanced' diet. The follow-up pie chart shows the change in knowledge and can indicate where further discussion needs to take place.

The children's comments proved useful to the teaching staff in targeting the direction of the nutrition programme over the following fortnight. Feedback helped to build up a good working relationship between the researcher and the staff involved and laid the foundation for further studies at the school.

One of the issues arising from this part of the research was that, in practical terms, it is difficult to achieve a balance over a single meal. It might be more appropriate for the children to draw a 'healthy balanced day'. This would give them more opportunity to include other foods from, for instance, the milk group and cereals group, for breakfast. This issue is explored further in section 4.3.2.

Summary finding

Using a draw and write method is a useful way for children to communicate nutritional knowledge. The use of drawings gives a greater insight into the knowledge of the children than is gained from simply listing the foods. The tool provides a simple method for teachers to assess children's nutritional knowledge. Teaching staff could use this method to ascertain areas of misunderstanding or lack of nutritional knowledge. Finally, the children were attentive and enjoyed the exercise; making this a practical classroom-based assessment activity.

4.3 Assessment of Knowledge

It is important to measure the nutritional knowledge of children in order to provide appropriate information and to monitor progress. It may be necessary to use more than one means of assessment. This section looks at the development of the draw and write method used in the preliminary studies. It also gives a brief summary of the food type questionnaire that was used as part of the dietary assessment tools and was discussed in greater detail in the previous chapter.

4.3.1 Healthy Balanced Meal

The consistency of the draw and write method was examined in children of the same age group but one year apart. The retention of knowledge was assessed in the second part of the exercise carried out several weeks after the school's nutrition education programme.

4.3.1.1 Method

Following the same procedure as that undertaken in the preliminary study, two 'Y5-96' classes (Dataset 6) were asked to draw a 'healthy balanced meal' at the beginning of the autumn term and again at the beginning of the summer term. The nutrition and health education fortnight took place in the middle of the spring term.

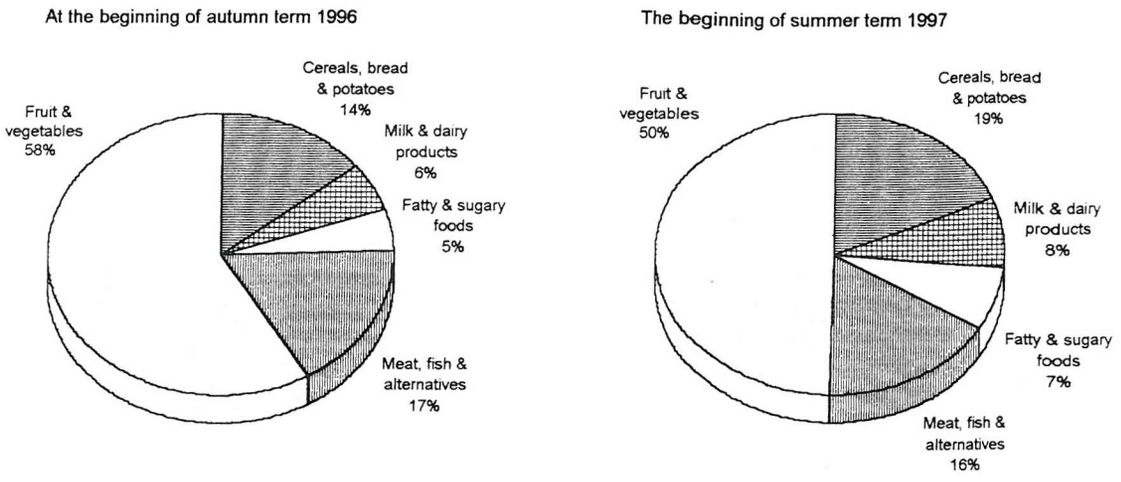
The children were also asked to give reasons why they thought that the meal they had drawn was healthy and balanced. The children were then asked to draw what they considered to be an unhealthy and unbalanced meal and to explain how they would improve the meal.

The drawings were analysed using the simple food group database.

4.3.1.2 Results

Forty-seven of the 'Y5-96' children completed both pre- and post-nutrition education drawings. It was found that there was a change in proportions between pre- and post-nutrition education for all the food groups. There was a smaller proportion of fruit and vegetables and meat, fish and alternatives and a larger proportion from each of the other groups (Figure 14).

Figure 14: Proportion of foods by food group, before and after nutrition education



However, as can be seen from Table 24, there was an overall increase in the number of items mentioned, rather than the large decrease in the number of fruits and vegetables drawn, which altered the overall proportions. Using a χ^2 test for the group as a whole, the difference in number of food drawn pre- to post-nutrition education just failed to reach significance ($\chi^2 = 8.91, p<0.10$).

Table 24: Number of foods by food group, before and after nutrition education (number of children=47)

Food Group	Number of foods drawn			
	Autumn term		Summer term	
	total	*mean*	*total*	*mean*
Bread, cereals and potatoes	48.5	1.0	72.0	1.5
Fruit and vegetables	200.0	4.3	191.8	4.1
Milk and milk products	19.0	0.4	30.5	0.6
Meat, fish and alternatives	58.5	1.2	63.5	1.4
Fatty and sugary foods	16.0	0.3	28.2	0.6
Total number of foods	*342**	*7.3*	*386**	*8.2*

* $\chi^2 = 8.91, p<0.10$

The comments on the healthy balanced meal and those on improving an unhealthy meal were similar to those from the preliminary studies. Again, these had been

collated and returned to the teaching staff on an anonymous basis to help with directing the nutrition fortnight.

4.3.1.3 Discussion

The teaching staff had used the results from the 'healthy balanced meal' exercise carried out with 'Y5-95' to inform their nutrition education practices. During the nutrition fortnight, they emphasised the need for a 'balanced' diet and the need for starchy foods. They also tried to teach the children that it was not just fruit and vegetables that were 'healthy' options. Foods needed to be chosen from each of the main food groups whilst foods from the fatty and sugary group should be restricted. The teachers told the children that the idea of a balanced healthy diet did not necessarily mean excluding foods, but altering the combinations of foods or changing to less fatty/sugary types of similar foods. The use of the 'The Balance of Good Health' guidelines helps to highlight the importance of a healthy balanced diet with the emphasis on eating a varied diet and sensible portion sizes without having to give up any particular foods completely.

Comparing the 'Y5-96' children with those from the previous year ('Y5-95'), showed no significant difference, either pre-nutrition education ($\chi^2 = 8.24$, $p<0.10$) or post-nutrition education ($\chi^2 = 6.32$, $p<0.10$).

4.3.2 Healthy Balanced Day

The initial work with the 'healthy balanced meal' did not allow sufficient scope for the children to incorporate all the elements needed to produce a healthy balanced option. Results from the preliminary study showed that, for example, the greatest proportion of the 'cereals, bread and potatoes' and 'milk and milk alternatives' groups were consumed at breakfast time, whereas a greater proportion of fruit and vegetables and the majority of meat, fish and alternatives were consumed as part of the main meal of the day (see Section 5.3.1).

For this reason, towards the end of the school year, the children who had previously been asked to draw a 'healthy balanced meal' before and after nutrition education were asked to draw the menu for a 'healthy balanced day'.

4.3.2.1 Method

Ten weeks after the nutrition education sessions, fifty-four 'Y5-96' children (Dataset 7) were given a sheet of A3 paper divided into the same meal and snack times that they used during other exercises (i.e. breakfast, mid morning, lunch time, during the afternoon, after school, evening meal, before bed). The children were asked to draw the foods they thought would constitute a 'healthy, balanced' day. They were also asked to label the foods. The children were told that they did not necessarily have to draw foods for all the meal or snack times. The pictures were then analysed according to the five food groups using the simple food group database.

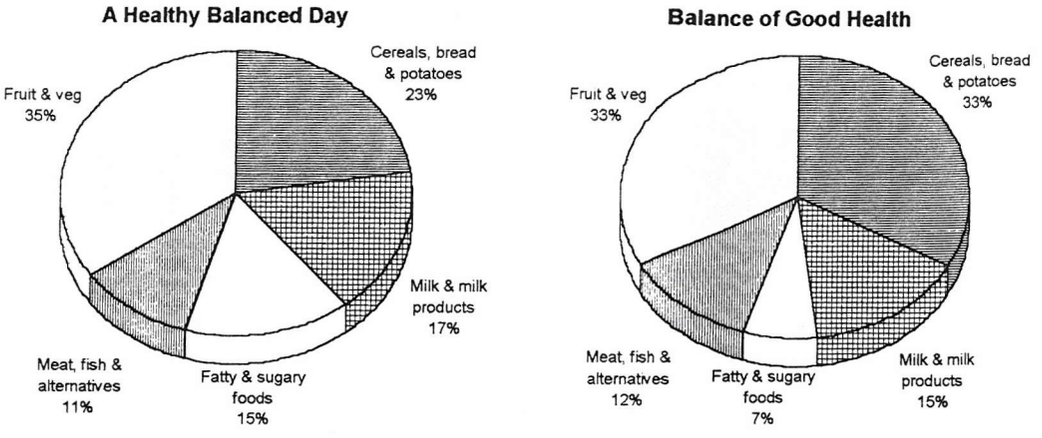
4.3.2.2 Results

For the 'Y5-96' group as a whole, the foods chosen by the children as part of their 'Healthy Day' menu were relatively close to the guideline proportions from the 'Balance of Good Health' for fruit and vegetable, meat, fish and alternatives, and milk and milk products. However, there appeared to be an under-representation of foods from the cereals group and an over-emphasis on the fatty and sugary foods (Table 25 and Figure 15).

Table 25: Percentage of foods by food group, children's drawings compared to the 'Balance of Good Health' guidelines

Food Group	Average number of foods	(%)	'Balance of Good Health' (%)
Cereals, bread and potatoes	3.7	23.2	33
Fruit and vegetables	5.4	34.5	33
Milk and milk products	2.6	16.6	15
Meat, fish and alternatives	2.0	11.1	12
Fatty and sugary foods	2.2	14.6	7

Figure 15: Percentage of foods by food group, children's drawings and Guidelines



An example of the types of food drawn by one of the children is given in Figure 16 below. The labelling helped to establish the children's knowledge of low fat/sugar versions of food. As can be seen in this example, the boy stated that the milk was semi-skimmed, cereal had no added sugar and the 'butter' was low fat.

Figure 16: Example of foods drawn by a 10-year-old boy for a 'healthy, balanced day'.

<table>
<tr><td>Breakfast

cornflakes
semi-skimmed milk
(no sugar)
brown bread toast
low-fat butter
strawberry jam
glass of orange juice</td><td colspan="2">Lunch

wholemeal bread
butter
cheese spread
packet of mini cheddars
apple
glass of water</td></tr>
<tr><td rowspan="2">Evening meal

roast potatoes
yorkshire pudding
chicken
broccoli
carrots
sweetcorn
gravy
glass of semi-skimmed milk</td><td>Mid Morning

a fresh orange</td><td>Mid Afternoon

glass of orange squash</td></tr>
<tr><td>After School

2 chocolate chip cookies</td><td>Before Bed

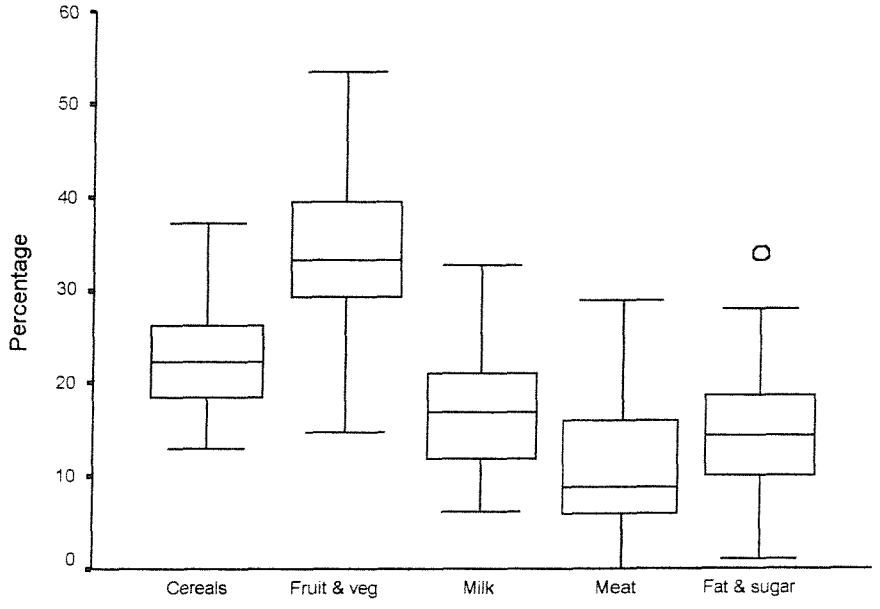
cup of cocoa</td></tr>
</table>

At an individual level there was a wide range, in percentage terms, for each food group. Table 26 presents the mean, standard deviations and range of proportions by food group for the 54 children. This can also be seen diagrammatically from the box plot (Figure 17) which shows the median, interquartile range, and the minimum and maximum values (excluding outliers) for each of the food groups.

Table 26: Mean, median and range of proportions of 'Healthy Balanced Day'

	mean	s.d.	median	lower quartile	upper quartile	minimum	maximum
Cereals	23.2	5.8	23.3	18.6	26.3	13.0	37.2
Fruit & veg.	34.5	9.4	33.3	29.4	39.6	14.8	53.5
Milk	16.6	6.1	16.9	12.1	20.9	6.1	32.7
Meat	11.1	8.4	8.8	5.9	15.7	0.0	28.9
Fat & sugar	14.6	7.1	14.3	10.1	18.6	1.0	33.9

Figure 17: Median and ranges by food group of 'Healthy Balanced Day'



o = outlier (cases with values 1.5 to 3 box lengths from the upper edge of the box)

4.3.2.3 Discussion

Focusing on a whole day's menu gave the children the opportunity to increase the range of foods they included in their drawings, and to incorporate more foods from the cereals group and the milk and milk products group. It may be worth considering asking the children to complete menus for several days, although this would be time-consuming and would therefore risk participant fatigue. It may be possible to carry out the exercise on several different occasions rather than in one session. However, the sessions would have to be relatively close together if we want to examine a child's knowledge at a particular developmental stage.

At a group level, the overall balance of foods more closely resembled the 'Balance of Good Health' guidelines than the output from the single meal. However, at an individual level some of the children did not appear to understand the 'Balance of Good Health' principles. This could be due to insufficient knowledge about the diversity of foods available, or it may reflect personal preferences.

As a means of assessing knowledge, the draw and write sessions worked well. The children were enthusiastic and informative. The results of the sessions were fed back at the group level, but it would be feasible to use each child's results for individually targeted nutrition education.

Characterising the 'Balance of Good Health' guidelines in terms of 'portions' per day (without quantifying the portions) may help children to achieve a better balance. After all, it would be better for children to aim to consume five small portions of fruit and vegetables than to eat one or two.

Summary findings

At a group level, the 'Balance of Good Health' assessment tool based on the simple food group database was capable of assessing nutritional knowledge and measuring change after nutrition education, using the analysis of a single 'healthy, balanced' meal. Since the assessment of the post-nutritional knowledge of 'Y5-96' was carried out ten weeks after their nutrition education lessons, it would appear that the children retained their knowledge over a period of time. Comparing the two different academic years, 'Y5-95' and 'Y5-96', there were no statistical differences either pre- or post nutrition education between the two groups. This suggests that the method is consistent across different groups of children.

Asking the children to develop a 'menu' for an entire day allowed for a better overall picture of what the children considered to be a healthy, balanced diet. Following nutrition education, the children appeared to understand the notion of a 'healthy, balanced' diet. However, the use of food group portion database may have overestimated the fat and sugar content of the children's drawings, and underestimated the bread, cereal and potatoes group.

Prepubescent children's knowledge of the fat/sugar content of foods and cooking methods used at home was incomplete. This may have implications for their ability to recognise healthy options. Boys seemed to have less knowledge than girls, although this was not statistically significant.

4.4 Food Type Questionnaire

It is important to establish whether children can relate the types of foods they eat to a 'healthy balanced' diet. If children do not know what they are eating, or understand how their food is cooked, they are unlikely to know whether or not they need to modify their eating habits.

4.4.1 Method

From the discussion group work with parents, a questionnaire was developed and piloted for use in the study. The questionnaire was then sent to participating parents in order to determine what types of foods were usually eaten by their child (e.g. type of milk, margarine, squash, fizzy drinks etc.). The questionnaire used 'closed' rather than 'open-ended' questions for ease of completion by the parents and children, and ease of data entry by the researcher. Fifty-seven 9 to 10-year-old children (Dataset 8) were asked to complete the same short questionnaire as their parents (Figure 18).

Figure 18: Food knowledge questionnaire

1.	What type of milk do you drink or have on cereal?	Whole milk (silver top)	☐
		Semi-skimmed	☐
		Skimmed	☐
		Other _____	☐
	I do not drink milk or have milk on cereal		☐
2.	What sort of butter or margarine do you have on bread or toast?		
	Brand name _____ e.g. Anchor butter, Delight, Flora		
3.	If you have a drink of orange is it usually	Pure orange juice	☐
		Orange squash	☐
		Low calorie orange squash	☐
4.	If you have a fizzy drink is it usually a 'Diet' or Low Calorie drink	Yes	☐
		No	☐
5.	If you have beefburgers cooked at home are they usually	Fried	☐
		Grilled	☐
6.	If you have fish fingers cooked at home are they usually	Fried	☐
		Grilled	☐
7.	If you have chips cooked at home are they usually	Deep fried chips	☐
		Oven chips	☐
8.	Do you have sugar in tea or coffee	Yes	☐
		No	☐
9.	Do you have sugar on cereal	Yes	☐
		No	☐
		Sometimes	☐

The questionnaire returned by the parents was compared with the same information provided by the children.

4.4.2 Results

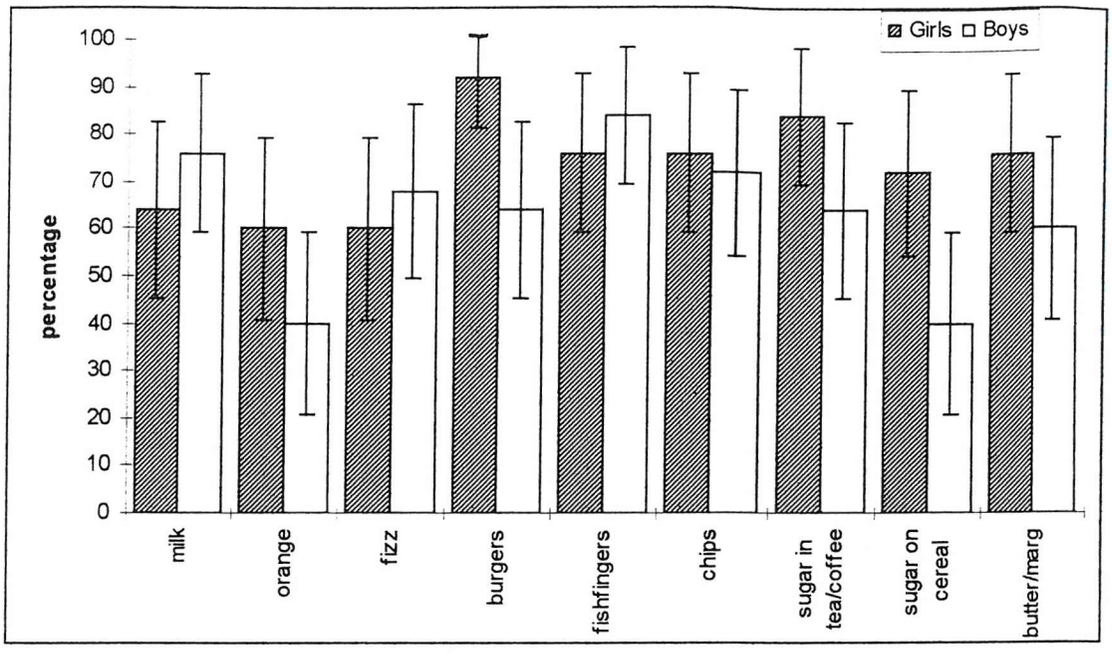
Fifty of the fifty-seven children's parents replied (87.7%). Taking the parent's responses as the 'truth', there was an overall agreement of 68.2%, with girls scoring better than boys (73.8% vs. 62.7%), although this difference was not statistically significant. As can be seen from table and figure below, the boys score least well on the questions about the sort of orange drink they would normally drink and whether or not they have sugar on their cereal. Most of the girls knew how burgers were cooked but were less sure when it came to fishfingers or chips. Overall, among the girls, agreement with parental report ranged from 60% for the type of orange or fizzy drink they usually consumed to 92% for the method of cooking burgers. The boys varied from 40% agreement on the type of orange drink and sugar on cereal to 84% agreement on the cooking method of fish fingers.

Table 27: Percentage agreement between children and their parents by question.

Question	Girls (%) (n=28)	Boys (%) (n=29)	Total (%) (n=57)
Percentage of parents responding	89.3 (n=25)	86.2 (n=25)	87.7 (n=50)
1. Type of milk	68	72	70
2. Type of butter or margarine	76	60	68
3. Type of orange	60	40	50
4. Type of carbonated drink	60	68	64
5. Cooking method - beefburgers	92[a]	64[a]	78
6. Cooking method - fish fingers	76	84	80
7. Cooking method - chips	76	72	74
8. Sugar in tea or coffee	84	64	74
9. Sugar on cereal	72[b]	40[b]	56
Overall percentages	*73.9*	*62.7*	*68.2*

Significant difference between girls and boys. a: p=0.01, b: p=0.02

Figure 19: Percentage of agreement and 95% confidence interval between child and parental food type questionnaires



Overall, there was no consistent pattern of over or under reporting food types by the children, with the exception of low calorie squash. Here only six children compared to seventeen parents reported usually drinking low calorie squash.

4.4.3 Discussion

It was found that, on average, the children were correct 68% of the time compared to parental information, and therefore there is still room for improvement. The girls scored higher than the boys (74% vs. 63%) but this did not reach statistical significance.

Although the scores between the boys and the girls were not statistically different, this may simply be a reflection of the small sample size. A sample size of approximately 380 children would be required to show a true statistical difference of this magnitude, with 90% power and 5% level of statistical significance.

This area could be targeted within the nutrition education sessions, with particular emphasis being paid to educating the boys, if a real difference in knowledge between girls and boys is found.

As the aim of the questionnaire is to provide information on 'usual' food types and cooking methods with particular reference to fat and sugar, this information could be used to enhance dietary assessment tools or in it's own right as a monitoring tool to monitor population dietary change over time.

If this tool is to be used to enhance information provided by other means such as food diaries, then the misclassification of foods due to incorrect information on food types and cooking methods could distort the truth. In general, girls seemed to be more aware of the types of food they ate and cooking methods. If this is a true difference then there is a likelihood of the overall balance of boy's diets being misclassified more frequently than that of girls. If this tool were to be used to assess a link between diet and disease then any observed association would be attenuated.

The degree of accuracy required of the tool will differ according to its use. If the diet is to be assessed with reference to the fat and sugar content of foods, then the degree of accuracy required is greater than that needed to simply allocate foods to the correct food group. The need for greater precision increases as the analysis by food group becomes more refined.

The analysis of the data assumed that the parental food type questionnaire provided the truth about the children's usual diet. However, it was not possible to validate the parent's responses.

Summary finding

Assuming that the parental food type questionnaire provide the 'truth', the children's knowledge of the fat/sugar content of foods and cooking methods used at home was not perfect. Boys appeared to be less knowledgeable than girls, although the difference was not statistically significant. The children's lack of knowledge about food types and cooking methods may have implications for their ability to recognise healthy options.

If the results of the questionnaire are to be used to enhance other dietary assessment methods, then, assuming that the parental food type questionnaire provide the 'truth', it may be more advantageous to use parental questionnaires than those of the children.

4.5 Development of Enhanced 'Balance of Good Health' Teaching Tools

4.5.1 Understanding the Food Groups

The applicability of the 'The Balance of Good Health' guidelines as an educational tool for prepubescent children is not established. It is not known if children of this age understand the notion of a 'balanced' diet and are able to allocate foods to the appropriate food groups in line with the concepts within the guidelines. It may be that the guidelines are too abstract and that prepubescent children require more prescriptive recommendations. Before the 'Balance of Good Health' guidelines can be used to promote a healthy balanced diet, children need to understand which foods belong to which food groups.

The following two sections describe the development and results firstly, of a simple group assessment exercise and secondly, of individual assessment and repeatability.

4.5.1.1 Measuring knowledge at the group level

In order to assess whether or not children from school years 5 and 6 could identify foods from the five different food groups they were invited to take part in a food 'game' (Dataset 9). Four Year 5 classes had just completed their nutrition education using the 'Balance of Good Health' guideline as a base for their work. Four Year 6 classes had followed the same course 12 months previously and had received no further formal nutrition education. There were, potentially, just over 230 children in the two school years available for the study.

Some of the children had been involved with other studies within this project (i.e. 'Y5-95' and 'Y5-96').

4.5.1.1.1 Method

Data from preliminary work was used to identify foods commonly eaten by children in this age group. Initially, one school year of approximately 120 children ('Y5-96') was available to take part in the exercise. To test the difference between girls and boys, two sets of identical foods were developed, one set for girls printed on blue card, a second set for boys printed on yellow card. Sixty different foods were chosen to reflect the proportion of foods from each food group as

recommended by the 'Balance of Good Health' guidelines, 20 from the cereals group (33%), 20 fruit and vegetables (33%), 9 milk and milk products (15%), 7 meat, fish and alternatives (12%), and 4 fatty and sugary foods (7%). Table 28 shows the list of foods and the order of distribution. The purpose was to present the children with a visual representation of the variety of foods in the food groups which could make up the plate.

When the second year ('Y6-96') became available for the experiment, a duplicate set of green and red cards were printed.

Table 28: List of foods used in the 'food game' and order of distribution

FAT & SUGAR	FRUIT & VEG	CEREALS
1 Crisps	4 Green Beans	5 Boiled Potatoes
6 Flora Margarine	9 Cauliflower	10 Jacket Potatoes
11 Cakes	14 Green Peppers	15 Mashed Potatoes
16 Lemonade	19 Mushrooms	20 Macaroni
MEAT GROUP	23 Broccoli	24 Spaghetti
2 Nuts	27 Cabbage	28 Noodles
7 Baked Beans	31 Beetroot	32 Pasta
12 Beefburgers	34 Cucumber	35 Brown Rice
17 Fishfingers	37 Tomatoes	38 White Rice
21 Roast Lamb	39 Sweetcorn	40 Branflakes
25 Eggs	41 Carrots	42 Rice Crispies
29 Chicken	43 Peas	44 Muesli
MILK GROUP	45 Raspberries	46 Weetabix
3 Angel Delight	47 Strawberries	48 Cornflakes
8 Milkshake	49 Kiwi fruit	50 Porridge
13 Cottage Cheese	51 Grapes	52 Burger Buns
18 Cheddar Cheese	53 Bananas	54 Hot Cross Buns
22 Custard	55 Apples	56 Wholemeal Rolls
26 Strawberry Yoghurt	57 Oranges	58 White Bread
30 Yoghurt	59 Pure Fruit Juice	60 Sliced Bread
33 Semi-skimmed Milk		
36 Milk		

The blue cards were systematically ordered to include all the foods from the fatty and sugary group, the milk and milk products group and the meat and meat alternatives group and distributed to the 'Y5-96' girls. The same method was used for the yellow cards for the 'Y5-96' boys. In the expectation that not all of the children would be present for the experiment it was considered better to have fewer cards from the cereals and fruit and vegetables groups than the others in order not to distort the overall proportions too much. The duplicate set of green and red cards were likewise systematically ordered and distributed to the 'Y6-96' children.

Five envelopes, representing the five food groups, were distributed around the room. The children were then told that they represented the food on the card they had been given and were asked to go to the food group they considered they belonged to. The cards were then placed in the envelope and the children stood together to form the different food groups. Once all the cards had been put in the envelopes the researcher then showed the children the food list in the form of the 'Balance of Good Health' pie chart. It was explained to the children that it was sometimes very difficult to decide to which food group certain foods belonged. Angel Delight was given as an example where, although it was a dessert and contained sugar, it was also made up with milk and could belong to the milk group. The children were then asked to remember which food they had been given and to go to the food group as they were shown on the food list. Once the groups were formed the children were asked to look at how many of them were in each of the food groups. It was then explained that the proportion of foods in each food group represented the proportion of foods that they should eat from each food group in order to have a healthy balanced diet.

The envelopes were returned to the researcher for further analysis. Group information was fed back to the children and their teachers.

4.5.1.1.2 Results

106 'Y5-96' children aged 9 to 10 (55 girls, 51 boys), and 99 'Y5-95' aged 10 to 11 children (52 girls, 47 boys), took part in a food group 'game'. Of the 'Y5-96' children, 52 of the girls (94.5%) and 50 of the boys (90.2%) identified the correct food group. Of 'Y6-96' children, 44 girls (84.6%) and 42 boys (89.4%) identified

the correct food groups (Table 29). There were no significant differences between the girls and the boys in either year, or between 'Y5-96' and 'Y6-96' using the χ^2 test (Table 30).

Table 29: Number (percentage) of correctly allocated foods, by year group and gender

Year and gender	Number correct	(%)
'Y5-96' - girls (n=55)	52	(94.5)
'Y5-96' - boys (n=51)	50	(90.2)
'Y6-96' - girls (n=52)	44	(84.6)
'Y6-96' - boys (n=47)	42	(89.4)

Table 30: Comparisons of 'Food Game' Scores

Comparisons	χ^2	*p* value
'Y5-96' - girls vs. boys	0.717	0.40
'Y6-96' - girls vs. boys	0.488	0.49
'Y5-96' vs. 'Y6-96'	1.736	0.19

The following are examples of types of foods the children allocated to the wrong groups. Crisps were put into the cereals, bread and potatoes group, lemonade with the fruit and vegetables, Flora margarine and eggs into the milk and milk products group, pasta into the meat, fish and alternatives group, hot-cross buns, Angel Delight and beefburgers in with fatty and sugary foods.

4.5.1.1.3 Discussion

In the case of wrongly allocated foods, the logic behind the choice of food group is evident and highlights the problem of differentiating the foods into their intended categories, a problem which may have to be explained in greater detail to prepubescent children.

It is not just children who have difficulties in deciding the food group allocation. The teachers involved in the food allocation exercise also admitted that they had difficulty in allocating some of the foods. For example, some foods may belong to more than one group - baked beans could be classified as a meat alternative or a

vegetable. Equally, the allocation of combination foods is often difficult, and this complex issue is considered in the following section.

4.5.1.2 Food Allocation Exercise

After conducting the "food game" experiment as a whole class exercise, it was decided to apply a similar exercise to individual children. If this nutrition knowledge assessment exercise proved feasible, teaching staff could use the results to target specific nutrition knowledge to individual children.

An experiment was set up to test the ability of 9 to 10 year old children to allocate a group of foods to the correct food group. In order to test the reproducibility of the experiment, the exercise was repeated ten weeks later.

4.5.1.2.1 Method

During academic year 1997/8, approximately eight weeks after the children's health and nutrition education fortnight, two 'Y5-97' classes of 9 to 10-year-olds (Dataset 10) completed a food allocation exercise.

Each child was given a piece of paper containing a list of 60 individual foods (the same foods as were used for the "food game"), two combination foods (sausage roll and cheese and tomato pizza) and five boxes representing the five food groups (Appendix A). A sausage roll is made of sausage meat (meat, fish and alternatives group) and pastry (fatty and sugary foods group). A cheese and tomato pizza consists of a bread dough base (bread, cereal and potatoes group), tomatoes (fruit and vegetables group) and cheese (milk and milk products group). This gave a total of 65 food group allocations.

The children were given coloured pencils and asked to colour code the five food groups as below.

Cereal group	orange
Fruit and vegetables	green
Milk and milk products	blue
Meat, fish and alternatives	red
Fatty and sugary foods	yellow

Bread allocated to the cereals group was used as an example and the children were told that sausage roll and cheese and tomato pizza belonged to more than one of the food groups. The children were then asked to allocate each of the foods to a food group (or groups).

Ten weeks later, the experiment was repeated with the same two classes of children. In total, forty-two of the fifty-six 'Y5-97' children completed the exercise on both occasions. These data were used to test the repeatability of the method. The repeatability of the study looked at the consistency of answers regardless of whether the answer was correct. A repeated answer was coded as 1 and a different answer was coded as 0. Each child then received a score of the sum of the repeated answers.

Assuming that the food allocation exercise would be administered on a single occasion, questionnaire 1 was analysed to identify the children's knowledge of the 'Balance of Good Health' food groups. In addition to the children who took part in the repeatability study, two further 'Y5-97' classes completed the food allocation questionnaire. This resulted in a total of 107 questionnaires available for analysis.

4.5.1.2.2 Results of Single Administration of the Questionnaire

On average, the 107 children allocated 71.4% of the foods to the correct food group. However, there was a large variation between individual foods. For example, all but one of the children correctly allocated milk to the milk group, whereas only 10% of the children allocated baked beans to the meat, fish and alternatives group. Figure 20, page 113 shows the distribution of foods by food group for those foods which were either not allocated or were allocated incorrectly by 50% or more of the children.

For the 'Y5-97' group as a whole, nearly 60% of bread, cereal and potatoes products were correctly allocated, ranging from 86% of children correctly allocating white bread to only 15% putting macaroni in the correct group. Thirty-nine percent of the children thought macaroni belonged to the milk and milk products group and a further 18% to the meat, fish and alternatives group. Eighty-three percent of the fruit and vegetables were correctly allocated ranging from 95% for tomatoes to 69% for green peppers. Almost 71% of milk products were

correctly allocated, though 'Angel Delight' was correctly allocated by only a third of the group (approximately 50% allocated it to the fatty and sugary foods group). In the meat, fish and alternatives group, chicken was allocated correctly 86% of the time, whereas eggs and baked beans were only allocated correctly by 12% and 10% of the children, respectively. On average the fatty and sugary foods were allocated correctly for 75% of the items. An exception was 'Flora' margarine, only 23% of the children considered it to belong to the fatty group. Nearly half the children (47%) allocated 'Flora' margarine to the milk and milk products group. Table 31 shows the percentage of correctly allocated foods by food group.

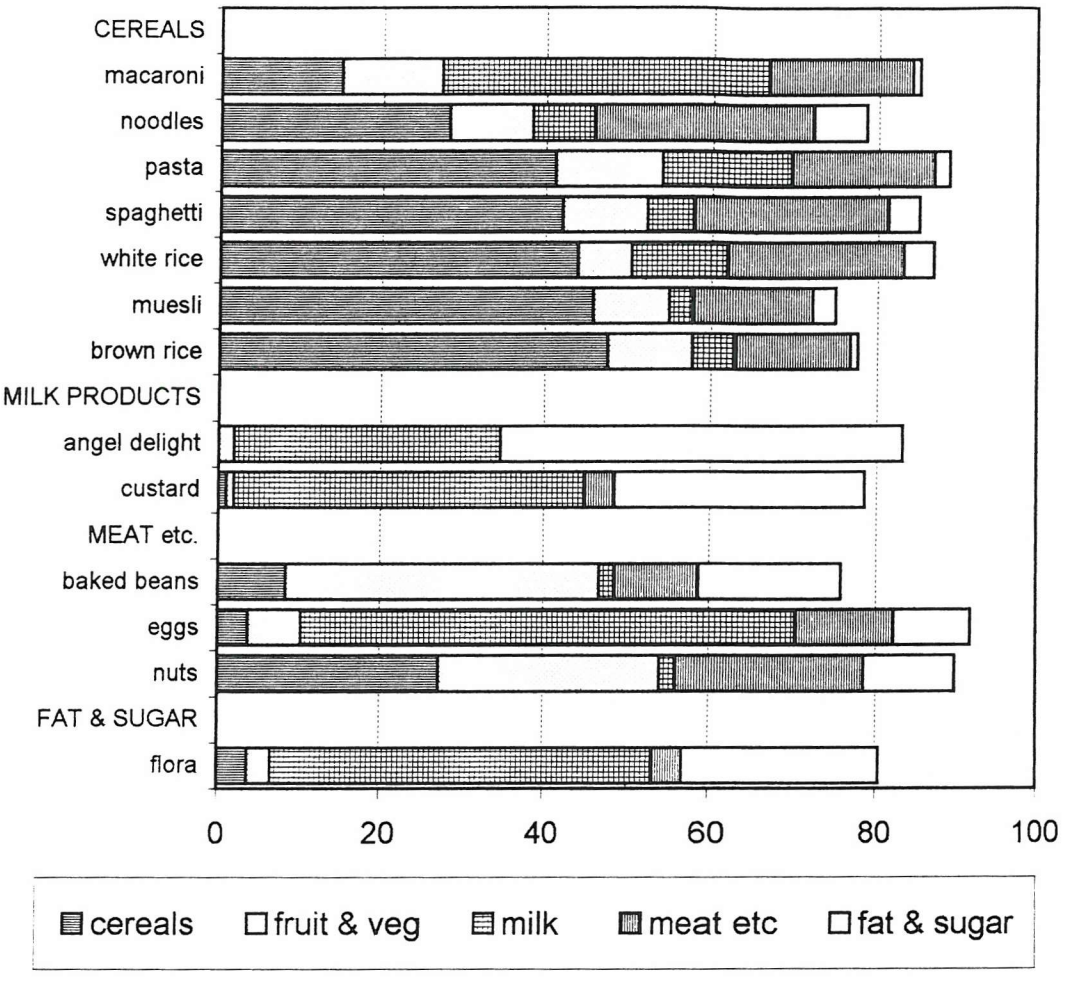
Table 31: Average correctly allocated foods by food group

Food Group	Average correctly allocated foods (%)
Cereals, bread and potatoes	59.6
Fruit and vegetables	83.5
Milk and milk products	70.7
Meat, fish and alternatives	50.9
Fatty and sugary foods	62.9

Often the misclassification of foods followed a logical pattern. For example, in the cereals group, 19% of children put porridge in the milk and milk products group as, for them, it was made with milk. Sixteen percent of the children allocated potatoes to the fruit and vegetables group, in spite of potatoes being clearly marked on the sheet as part of the bread, cereal and potatoes group. Of the protein foods, almost 60% of children allocated eggs to the milk and milk products group. Nuts were allocated to cereals (27%), fruit and vegetables (27%) and fatty and sugary foods (11%). Baked beans were not considered to be an alternative to meat or fish by the majority of the children, 38% allocated them to fruit and vegetables and 17% to the fatty and sugary food group. Many children did not consider custard or milkshake to belong to the milk and milk products group, they were allocated to the fatty and sugary foods group by 30% and 26% of the children respectively. Eight percent of the children thought crisps belonged to the bread,

cereal and potatoes group. These findings imply that there is a need to improve nutrition knowledge about the 'Balance of Good Health' food groups.

Figure 20: Distribution of foods by food group for those foods that 50% or more of children allocated incorrectly



Two combination foods (cheese and tomato pizza and sausage roll) were included to determine children's understanding of the division of mixed dishes into the five 'Balance of Good Health' food groups. It was found that children had great difficulty in allocating these foods to the correct food groups. More than a quarter of the children failed to allocate pizza and almost 18% did not allocate sausage roll to any of the food groups. Of those children who did allocate pizza to food groups, a third them did not recognise that pizza base belonged to the bread, cereal and potatoes group, 22% did not allocate tomato to the fruit and vegetables group and 9% did not put cheese in the milk and milk products group. For the

sausage roll, 73% recognised that part of it belonged to the meat group, 35% allocated part of it to the fatty and sugary foods group and 40% thought that a portion of it went to the bread, cereal and potatoes group.

Overall, the ability of the children to allocate foods to food groups varied enormously but, even if incorrectly allocated, there was often logic in the groups they chose. In general, they were relatively good at allocating a given foods from the food list and they were more likely to miss out a food rather than allocate it to the incorrect food group.

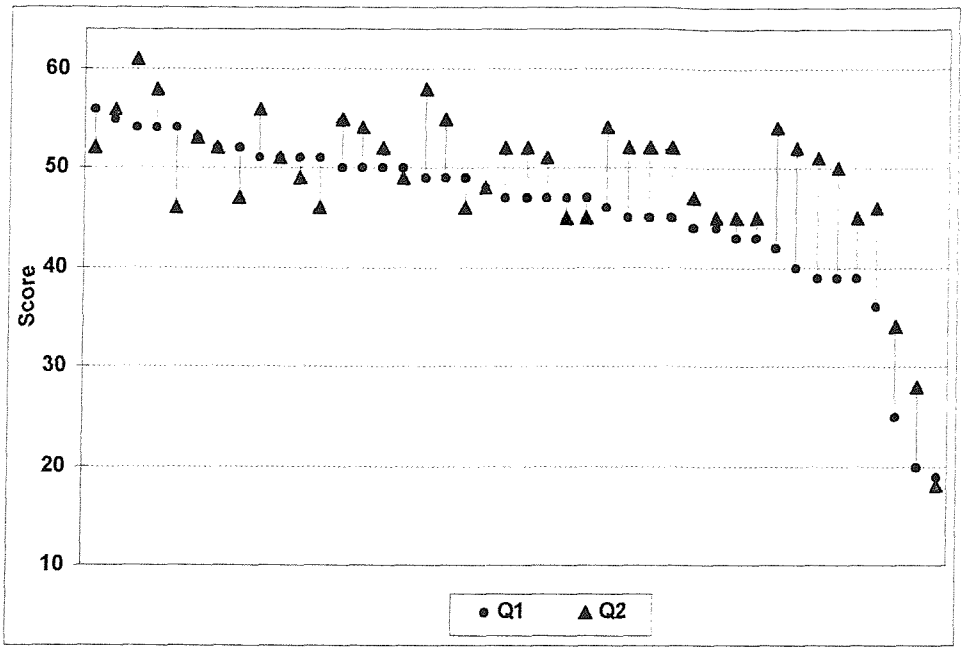
4.5.1.2.3 Results of the Repeatability Study

As the children were given bread as an example, the maximum feasible score for the exercise was 64 (59 from the individual foods listed plus 5 from the combination foods). The mean score was 47.9 (s.d. 6.5) out of a maximum of 64, meaning the children repeated their original allocation for 74.8% of items.

The average score for the first exercise (Q1) was 45.7 (s.d. 8.4) and for the repeat study (Q2) was 49.0 (s.d. 7.7). There was a significant overall improvement between the two scores of, on average, 3.4 (s.d. 5.1) $p<0.0001$ using the paired t-test. Figure 21 shows the plot of the two scores. The correlation between the two scores was highly significant, $r=0.8$ ($p<0.0001$).

When grouping the results of each questionnaire into thirds, 48% of the children were in the same third, and only 9% in the opposite third.

Figure 21: Scores for Questionnaire 1 (Q1) and Questionnaire 2 (Q2)



* Scores for Q2 significantly higher than Q1. Paired t-test $p<0.0001$
** Significant correlation between Q1 and Q2 scores. $r=0.8$ $p<0.0001$

Summary finding

Post-nutrition education, the majority of the children correctly allocated most of the foods on the food list. This would suggest that, following nutrition education using the 'Balance of Good Health' guidelines, children were able to identify foods from the different food groups. This is obviously an important first step in understanding the concept of the 'Balance of Good Health' food guidelines. However, foods with more than one component or those usually eaten as a component part of a recipe, such as milk puddings or macaroni, often caused confusion. This implies that prepubescent children require more prescriptive information about specific foods and combinations of foods.

In general, this food allocation exercise is a useful way to highlight the different types of food that can belong to each of the food groups and could be used by teachers to explore food groups further.

4.5.2 Substitute Foods

During the work undertaken to develop tools to assess dietary behaviour in prepubescent children (see Chapter 5), twenty 'Y5-96' children completed 4-day weighed records. It was found that the calculated energy intake of this group was within the expected range for their age in order to sustain growth and maintain activity levels. If children are to be encouraged to alter their eating habits, then it is necessary to make sure that appropriate energy levels are maintained and desirable nutrient densities are achieved. Whilst altering the balance of children's diets away from high fat and sugar foods to lower fat or sugar varieties, it is important to encourage them to substitute other foods.

The division of foods into the five food groups, determined within the 'Balance of Good Health' guidelines, is rather simplistic. Measuring changes in the eating behaviour of children using just the five food groups will show any alteration between food groups but will not measure change within the groups. If a tool is to be used to identify knowledge, attitude or behavioural modifications, then it will have to be sensitive enough to identify modest changes within each food group.

To encourage change in dietary habits children need, to be able to see the effect of dietary change on the overall balance of their diet. One feedback mechanism could be the analysis of their diet in the form of the 'Balance of Good Health' plate before and after any dietary changes. However, simple allocation of foods to food groups does not take account of the other important messages within the 'Balance of Good Health' guidelines, namely eating lower fat and sugar versions of foods and the consumption of more wholegrain foods. Dividing foods within food groups into categories according to fat, sugar (and possibly fibre) content would allow children to see the effect of changes within as well as between food groups.

4.5.2.1 'Towers'

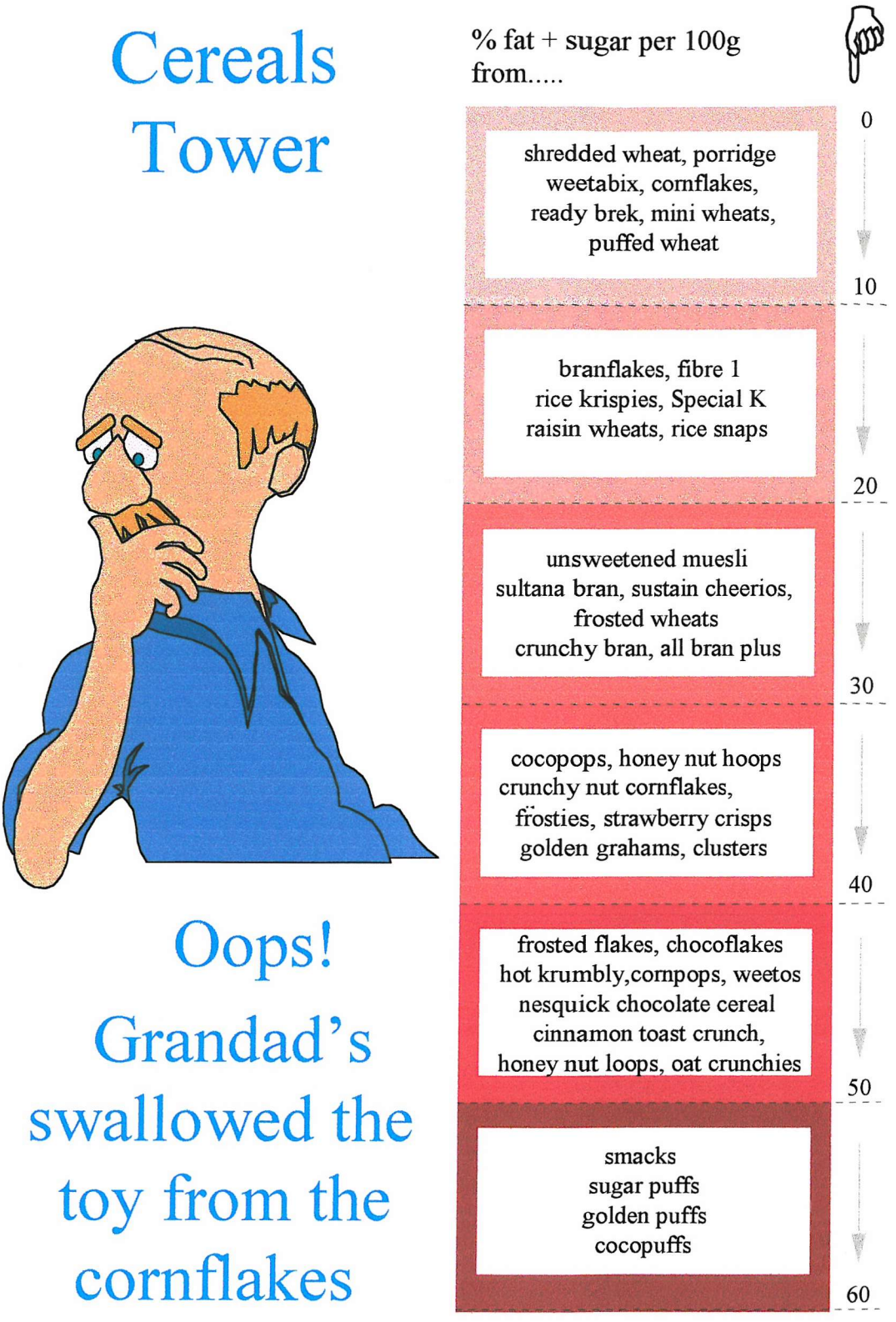
To assist children's understanding of the concept of the different fat and sugar contents of foods, and to help them make informed substitution choices, the researcher developed a simple tool. The tool took the form of a 'tower'. A 'tower' could be constructed for any food group, for example breakfast cereals, savoury

snacks or cakes and biscuits. The idea of the 'tower' was to produce an easy-to-use visual reference for children to identify the fat and sugar content of certain foods. The 'towers' grade the foods from low fat and/or sugar at the top to high fat and/or sugar at the bottom. It is then easy to see which food could be substituted for another in order to move up the 'tower' and therefore reduce the consumption of fat and sugar.

The consumption of ready-to-eat breakfast cereal is common among children of this age group (Gibson and O'Sullivan, 1995; Nicklas *et al.*, 1995; Ruxton *et al.*, 1996b). The cereal 'tower' was developed as a means of showing the children that, by choosing a cereal from one of the lower fat and/or sugar groups rather than one of the higher groups, they can modify the fat and sugar content of their diet.

The breakfast cereals were divided up according to manufacturer's nutrition information on the number of grams per 100 grams of total fat and sugar. The cereal 'tower' has been graded from low fat plus sugar '**<10**' (i.e. less than 10 grams per 100 grams of cereal), with a pale border, down to high fat plus high sugar '**>50**' with a dark border (Figure 22). No account has taken of fibre or salt content at this stage but may be incorporated in a future version of the 'towers'. The calculations did not include milk.

Figure 22: Breakfast Cereals 'Tower'



N.B. The original figure is in colour.

4.5.2.2 Identifying Nutrients from Labels

In order to construct the 'towers', prepubescent children need to be able to identify nutrients from food labels. The objective of this experiment was to assess whether 9 to 10-year-old prepubescent children could determine the different proportion of nutrients in foods from food labels.

4.5.2.2.1 Method

Towards the end of the 1996/7 academic year, two 'Y5-96' classes of children (Dataset 11) were presented with a sample of labels from popular breakfast cereal packets and shown how to identify the percentage of sugar and total fat in the cereal. They were then shown a blank version of the cereal 'tower' (Figure 22) and told what the different boxes meant.

Eighteen different varieties of breakfast cereal packets were distributed around the classroom and the children were asked to identify the amount of sugar and fat per 100 grams and to add the two numbers together for each of the packets of cereals. The children were then asked, as a class, to determine which 'tower' category a selection of cereals belonged. This was a preliminary exercise to familiarise the children with the concept of the 'tower'.

Each class was then given 'homework' to collect the fat and sugar data from as many different boxes of breakfast cereal as they could find. It was set as a competition between the two classes to maximise the response rate. The following day the data were collected from the two classes and, having checked that the information supplied was correct, a 'tower' was constructed of all the identified cereals.

4.5.2.2.2 Results

All the information from the children on breakfast cereals was checked with manufacturers' data by the researcher. The results of the data collection exercise are shown in Figure 22. At the end of the year, the completed 'tower' and a summary of the results of the work the class had done throughout the year was given to each child.

4.5.2.3 Understanding the 'tower' groups

In order to test their comprehension, the children were invited to participate in an exercise involving ready-to-eat breakfast cereal. The 'Balance of Good Health' guidelines used as part of the children's nutrition education lessons focus on the balance of foods between food groups and simply advise that the consumption of lower fat and sugar versions of foods were preferable. This was part of a development that enhances the 'Balance of Good Health' guidelines by showing prepubescent children which foods they can choose to modify their diet.

4.5.2.3.1 Method

Two weeks after collecting the cereal packet data, the researcher returned to the 'Y5-96' classes (Dataset 11) for further experimental work and to report the results. At the second session, before reporting back on the 'tower', the children were each given a piece of paper with the name of a breakfast cereal and its fat and sugar content per 100g, to one decimal place. Working on their own the children were asked to add the two numbers together, write it on the piece of paper, then decide to which of the 'tower' groups that cereal belonged. The children were then told to put their piece of paper in one of six envelopes, each one representing one of the 'tower' groups

4.5.2.3.2 Results

Fifty-five children took part in the cereals allocation exercise. Only 38/55 (69%) of the children got the arithmetic right and allocated the cereal to the correct 'tower' group. Of the children who got the wrong answer, 11/17 (65%) allocated it the appropriate group for their answer.

4.5.2.3.3 Discussion

The majority of the children (almost 90%) clearly understood the concept of the allocation to the 'tower' groups of cereals by fat and sugar content. Of particular concern is the fact that almost a third of the children were unable to add together two numbers containing a decimal. These children were at the end of their penultimate year at primary school and could be expected to cope with the arithmetic. If this simple tool is to be used to enhance the 'Balance of Good

Health' guidelines in this age group, then the standard of basic arithmetic needs to be raised.

Summary finding

The majority of children were able to identify the fat and sugar content of the breakfast cereals from the product label. They were also able to allocate the breakfast cereal to a 'tower' group. Unfortunately, many children could not compute the total fat and sugar content per 100 grams. If this is a general finding in this age group, then the use of nutrient labels is limited.

4.6 Chapter Summary

A draw and write method was employed to determine children's knowledge of a healthy balanced meal. The drawings were analysed using the simple food group database described in Chapter 3. From the results, it was clear that this was a viable method for children to communicate nutrition knowledge. The use of drawings increased the amount of detail given compared to written information. For example, children would write 'orange' but draw a carton of orange squash. Teaching staff were able to utilise the results from this method to highlight areas of misunderstanding or lack of nutrition knowledge in the children. This was used to inform further nutrition education. An additional advantage of the method was that the children enjoyed the exercise.

Further studies using the draw and write method looked at the changes in children's knowledge following nutrition education. There were demonstrable differences in children's perception of a healthy, balanced meal pre- and post-nutrition education. The use of the 'Balance of Good Health' dietary assessment tool based on the simple food group database clearly demonstrated the ability of the tool to measure change in knowledge. A comparative study carried out a year later in the same age group of children showed no statistical differences between the two groups.

It was felt that the use of a single meal did not allow sufficient scope for the children to communicate the range of their knowledge of a healthy, balanced diet.

Extending the remit to cover a whole day allowed the children to include a greater variety of foods. The result was a more balanced picture.

Children's knowledge of the fat and sugar content of selected foods and cooking methods used in the home was examined using a short food type questionnaire. From the results of the food type questionnaire, it would seem that prepubescent children were not always aware of the types of food they ate or the cooking methods used in the home. Girls appeared to have better knowledge than boys, but the overall difference was not significant. If children are not aware of the kinds of foods they eat, then it will make it more difficult for them to recognise healthy options.

In practical terms, for children to be able to use the 'Balance of Good Health' guidelines, they must be able to identify which foods belong to which food group. To assess this knowledge, an experiment was set up to determine children's ability to correctly allocate a series of foods to the relevant food groups. For the majority of the children, their knowledge was relatively good. Confusion arose where foods comprised of more than one ingredient. For example, 'Angel Delight' (a milk-based instant dessert) was often allocated to the fatty and sugary foods group. Children seemed to be unaware of the high proportion of milk in the product. However, this type of confusion is not confined to the prepubescent population. As teaching staff confirmed, adults can find problems with the allocation of composite foods. The information provided by this exercise could be used by teaching staff as the basis for further nutrition education using the 'Balance of Good Health' guidelines as the foundation. Carrying out the exercise pre- and post-nutrition education would be a good way to assess change in pupil's knowledge.

If children are expected to recognise healthier options, then they should be able to use nutrition information provided on packaging. Breakfast cereals are a good example of a product with a wide range of fat and sugar content. In an experiment to identify children's ability to calculate the fat and sugar content of breakfast cereal, the children were shown how to obtain the information they needed from the nutrition labels. They were then asked to compute the fat and sugar score. Unfortunately, the arithmetic skills of many of the children was insufficient for them to calculate the score correctly. Unless arithmetic skills can be improved, it

is unlikely that many children of this age could use nutrition information available on product labels.

Children may then require an alternative means of identifying the lower fat and sugar varieties of foods. The poor result of the nutrition label exercise led to the development of the 'towers'. 'Towers' are based on specific food types; for example breakfast cereals, cakes or biscuits. The foods are divided into groups ranging from low fat/sugar varieties at the top down to high fat/sugar varieties at the bottom. When using these 'towers', children were able to understand the concept of substituting lower fat/sugar varieties of foods.

If children understand the concept of substituting one food for another, then creating a list of substitute foods may be a step in the right direction. Before children can make effective changes in their diet, they must be able to recognise the elements of their diet which need altering and be empowered to do so, i.e. they must be able to make choices in what they eat. Nutrition education will help children to understand their diet, but it is up to parents, schools, shops and catering establishments to supply healthy options from which children can choose.

Nutrition education is vital in providing a sound basis from which people can make an informed choice about the foods they eat. This is particularly important for prepubescent children, as puberty and adolescence are periods in which many life-long habits are formed (Sweeting *et al.*, 1994). The methods set out in this chapter may help children understand and utilise the 'Balance of Good Health' guidelines effectively, both now and in the future.

5 Development of Dietary Assessment Tools

Objective

5. i) To identify and develop appropriate methods to allow children to communicate information on current diet and usual food habits.

   ii) To compare methods and assess the repeatability of the tools.

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This chapter looks at the development of a range of dietary assessment tools for use with prepubescent children. It is intended that the information, analysed using the simple food group database developed in Chapter 3, will be able to describe food consumption patterns at a group level, in terms of the five 'Balance of Good Health' food groups.

The first part of the project was conducted in the academic year 1995/6, with the same Year 5 class of children that took part in the Preliminary Studies (Chapter 2), and looks at the feasibility of using the 24-hour recall method with prepubescent children (section 5.2.1). The second part was carried out with two Year 5 classes at the same school during the academic year 1997/8 and examines two different approaches for 24-hour recalls in prepubescent children (section 5.2). Section 5.3 looks at the development of food diaries. Section 5.4 looks at the issues of reliability of reporting by prepubescent children. Section 5.5 compares food diaries with a reference standard. A summary of the chapter is given in section 5.6.

5.1 Introduction

Dietary assessment is a complex but essential part of defining dietary behaviour. Many studies have looked at the dietary intakes of babies, very young children and adults but few have assessed diet in prepubescent children. Dietary assessment of children frequently uses information provided by an adult. In young children this is likely to be a good proxy but as children get older and gain more independence, adults may be less aware of all the foods the children eat. Getting children to provide their own dietary information may provide more accurate information. Using the child as the sole informant has the additional advantage of allowing information to be gathered within school, thus reducing the cost.

If dietary information is to be collected from children directly, then the assessment method must be suited to their cognitive skills. For accurate dietary assessment it is necessary that children not only recall or record the foods they have eaten, but that they are able to distinguish between varieties within the same food type, have knowledge of preparation and cooking methods and can report added ingredients.

Work was undertaken to adapt two dietary assessment tools - a 24-hour recall and a 4-day food diary - for use with a sample of prepubescent children. The two techniques examine different aspects of dietary assessment. A 24-hour recall gives limited information on usual diet but may be a good estimate of average consumption at a population level for this age group. A food diary looks at current eating habits and could be used for individual counselling. Preliminary findings indicated a need to develop a third technique, a food type questionnaire. A food type questionnaire provides information on usual patterns of selected foods.

5.2 Development of 24 Hour Recall Methodology

From a review of the literature (Chapter 1, Section 1.7.4) it was clear that the use of 24-hour recalls was one of the few methods which could be adapted for use in a population of prepubescent children; this section looks at two possible approaches.

Food recalls are retrospective and provide a snapshot view of current diet. Although a single recall is not enough to describe the diet of an individual child, a

set of recalls from a group of children may be sufficient to describe intake at the population level. This may be an appropriate method for obtaining dietary information from prepubescent children if they have the ability to remember what they ate and sufficient skills to communicate that information. Domel *et al.* found that fourth grade pupils had four main retrieval mechanisms for remembering what they ate for lunch (Domel *et al.*, 1994b). The pupils, interviewed within an hour and a half of eating lunch, used visual imagery (e.g. recalling colour, shape and consistency of foods), preference (e.g. whether they liked the food or not), behaviour chaining (i.e. association with other foods or activities) and usual practice (i.e. what they habitually ate). The children correctly reported 69% of food items with no prompting. This increased to 90% with prompts.

5.2.1 Written Recalls

The ability of prepubescent children to provide a written recall of foods eaten within the previous 24 hours was examined using Dataset 12. This Dataset consisted of the 'Y5-95' class of 9 and 10-year-old children, plus one other child who joined towards the end of the academic year. This gave 32 children available to help answer the question of recall reliability (mean age 10.4, s.d. 0.3). The results were measured against details supplied by their parents.

5.2.1.1 Method

A pre-printed log sheet and a letter containing details of the project were sent home with the children. (Appendices B and C). The parents were asked to note down on the form everything they knew their child ate on the Sunday. It was important that the child remained unaware that what they ate was being recorded. Parents were assured that they need not worry if they were unsure of anything their child had eaten outside the home, but that they should simply note that the child was out and record what they could. Sunday was chosen for the recording day as this was likely to be the time when most children spent the day with their parents.

At school the following morning, the children were asked to recall everything they ate the day before. They used an identical form to the one supplied to their parents. The form was divided into sections largely based around meal times,

since preliminary work had shown this to be an appropriate way for children of this age to recall what they ate (Appendix D). In order to improve recall, the children were asked to remember what activities they had been involved in during the day. No further prompts were given.

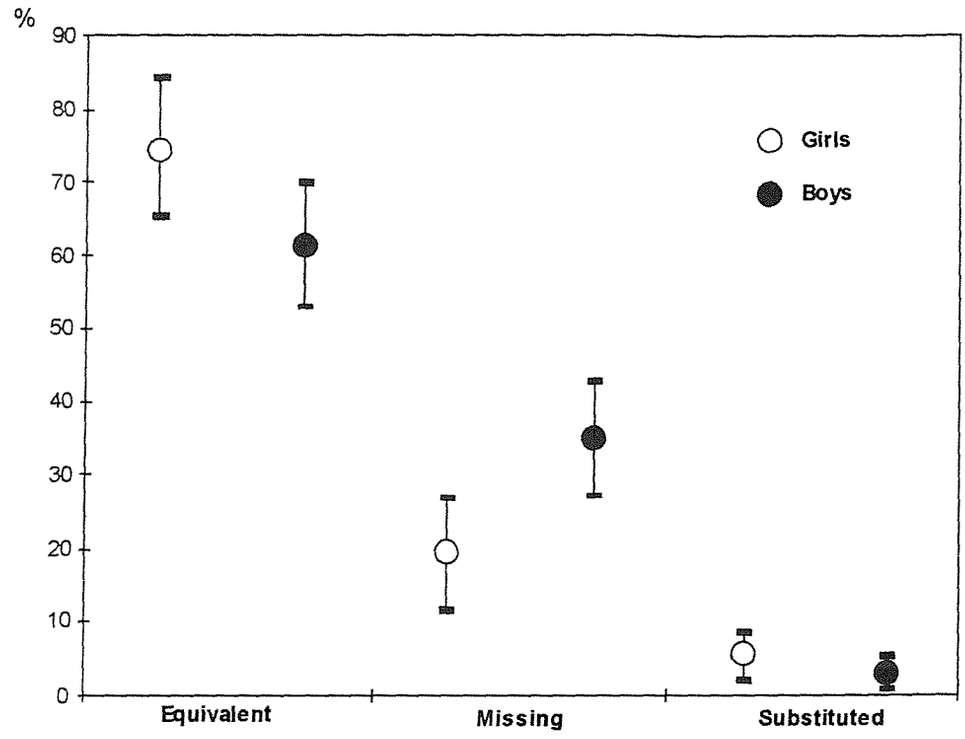
As an exercise for the children to become familiar with the 24-hour record sheets, they had previously been asked to record everything their mother/father ate while they were with them, without their parent knowing. The next morning they asked their parents to fill in what they had eaten the previous day on an identical form. This record was then returned in a sealed envelope together with the parents recording of what the child ate on the Sunday.

5.2.1.2 Results

Of the 32 children whose parents were sent details of the project, 3 boys and 1 girl did not return a 24-hour diary completed by their parents. Of the 24-hour recalls completed by the children, one boy with learning difficulties had such difficulties recalling anything he ate the previous day that there was no correlation between his record and that of his parent. This record has been excluded from further analysis. This left 27 records for analysis (16 girls and 11 boys), a response rate of just over 84%.

Taking the parental diary as the definitive list, boys generally consumed a greater number of food items than girls (mean 18.3 [s.d. 2.6] and 16.6 [s.d. 3.7] respectively). The difference was not statistically significant. The overall percentage of foods listed by the parents that were also recalled by the children was 69.5% (c.i. 62.2-76.8%). A further 25.6% (c.i. 19.3-32.5%) of the foods were missing from the children's recall sheets and 4.6% (c.i. 2.4-6.9%) were substituted for similar products (for example, cauliflower instead of broccoli). Figure 23 shows the percentages and 95% confidence intervals by sex.

Figure 23: Percentage and 95% confidence intervals by gender of recalled foods that matched parental list.



There was a difference in the overall percentage recall between the girls and the boys. On average, the girls correctly recalled 75.0% (c.i. 65.5-84.5%) of the foods listed by the parents, had 19.4% missing and had substituted the food for a similar product 5.6% of the time. The boys recalled 61.5 % correctly (c.i. 53.1-70.0%), missed 35.2% and substituted 3.2% of foods. Using a two-tailed *t* test the difference between the percentage recall of girls to that of boys just failed to reach significance at the 5% level (p=0.06).

The children recalled additional foods, not listed by the parents (girls 1.9%, boys 8.4%). The majority of these foods were drinks or snack foods such as sweets, crisps, fruit and ice-cream. As most of these foods do not form part of a main meal, they may have been consumed by the children without the knowledge of the parents. It is also possible however, that they may be phantom foods, that is, the children recorded a food they did not eat.

There was no significant correlation between chronological age (measured in tenths of a year) and the children's ability to correctly recall their previous day's

diet. With such a narrow age band and so few children, this is not unexpected. The cognitive and physical development of children is known to be variable between children of the same chronological age.

5.2.1.3 Discussion

A US study of 8 to 10-year-olds found that, with the aid of a food record and one-to-one interviewing, children could recall approximately 80% of the foods that they were observed to have eaten (Lytle *et al.*, 1993). Van Horn *et al.* used telephones and tape recorders to obtain 24-hour recall data from 54 children aged 8 to 10-year-old (Van Horn *et al.*, 1990). As a training session, the children and parents had a face to face interview to recall the previous day's intake. The researchers collected information on food type and portion size (the children had been taught to use food models, photographs and household measures to estimate portion size). Overall, 67% of the food items recorded by the parents were correctly recalled by the children, 18% of foods were under-reported and 15% over-reported. In another study, Crawford *et al.* found that for individual foods, 9 to 10-year-old girls under-reported by a median of 30% and reported phantom foods 33% of the time (Crawford *et al.*, 1994).

Although the difference in recall rates between girls and boys was not statistically significant, this may be due to the size of the sample. If we assume that the average recall rate is 70% in this age group and we wish to detect a difference of 10% between the sexes, with 90% power and 5% level of statistical significance, we would require a sample of more than 440 children. Even with only 80% power we would still need a sample of 330 children to detect a difference of 10% between the genders. Further research is required to look at potential biases of under- and over-reporting, and to determine if there is a true difference in recall ability between genders which may lead to bias.

With the food group based method developed in this project, as foods of a similar type are allocated to the same food group they are counted as being correctly recalled. Traditionally, these foods would be classified as missing or phantom foods, thus reducing the recall rate. Therefore, if we are looking at the balance of food groups, the average recall rate of almost 70% may be sufficient to derive accurate proportions of foods between the five food groups at a population level.

However, if there are differential rates of recall by food group then the validity of the tool may be in doubt. This is examined in the next section.

It should be noted that no distinction was made between high and low sugar or fat versions of foods when analysing the children's recalls. The children themselves often simply identified the food item without further description. For example, a child may recall "a glass of milk" where as the parent would state that the child had "a glass of semi-skimmed milk". Once again, this raises the issue of whether or not prepubescent children correctly identify when they eat lower fat or sugar varieties of foods. (See Section 4.4).

Summary finding

If there are no differences between the sexes, or any differences can be calibrated, and there are no differential recall rates by food group, then the use of a 24-hour recall would be an inexpensive way to measure dietary intakes in this age group, at a population level.

5.2.2 Drawn versus Written Recalls

Following on from the initial work it was hypothesised that children may be able to recall their diet more successfully by drawing rather than listing the foods. The two different approaches are compared below. Again, details from parents were used to verify the information received from the children.

5.2.2.1 Method

During academic year 1997/8, the parents of two 'Y5-97' classes of 9 to 10 year-old children were sent a pre-printed log sheet and a covering letter explaining the project. The parents were asked to note down on the form everything they knew their child ate on the Sunday, without the child being aware of it being recorded. These children formed Dataset 13.

On the Monday morning, the children were asked to recall everything they ate during the previous 24 hours. Class A were asked to firstly draw everything they ate, the drawings were collected and they were then asked to list the foods they ate. Class B completed the recalls in the opposite order. The picture sheets and lists were divided up into the same time periods that were previously used to collect recall data from this age group (i.e. breakfast, during the morning, lunch, during the afternoon, evening meal and before bed). The children were encouraged to remember the activities of the day as well as the foods in order that this may facilitate their memories.

The lists, drawings and log sheets were analysed using the simple food group database as described in Chapter 3, Section 3.4.

5.2.2.2 Results

Fifty-seven parents received letters, 7 parents did not return the list of foods eaten and 2 children did not attend school on the following Monday. In all, forty-eight of the children who completed the recalls of everything they ate, had a food record completed and returned by their parents.

A comparison of the lists and the pictures to the information provided by the parents showed no significant differences between the two classes. Therefore the data from the two classes was combined for further analysis. The following abbreviations are used throughout this section: 'Listed' means the 24-hour recall listed by the children, 'Drawn' is their drawing of the 24-hour recall, and 'Parents' is the parents report of what the children ate.

Table 32 gives the mean, standard deviation, minimum and maximum number of foods by food group, for each method of recall and for the parental report group.

Table 32: Average number of portions by Food Group from 24 hour recalls a) Listed by Children, b) Drawn by Children and c) Reported by Parents

a) Listed by Children

Food Group	Mean	SD	Min	Max
Cereals	2.95	1.01	1.0	6.0
Fruit and vegetables	2.91	2.31	0.0	11.0
Milk	1.47	1.06	0.0	3.5
Meat	1.65	0.87	0.0	4.0
Fat and Sugar	2.55	1.48	0.1	7.7

b) Drawn by Children

Food Group	Mean	SD	Min	Max
Cereals	2.94	0.93	1.0	5.0
Fruit and vegetables	2.77	1.83	0.0	8.0
Milk	1.53	1.01	0.0	4.0
Meat	1.81	0.91	0.5	4.0
Fat and Sugar	2.27	1.17	0.0	4.8

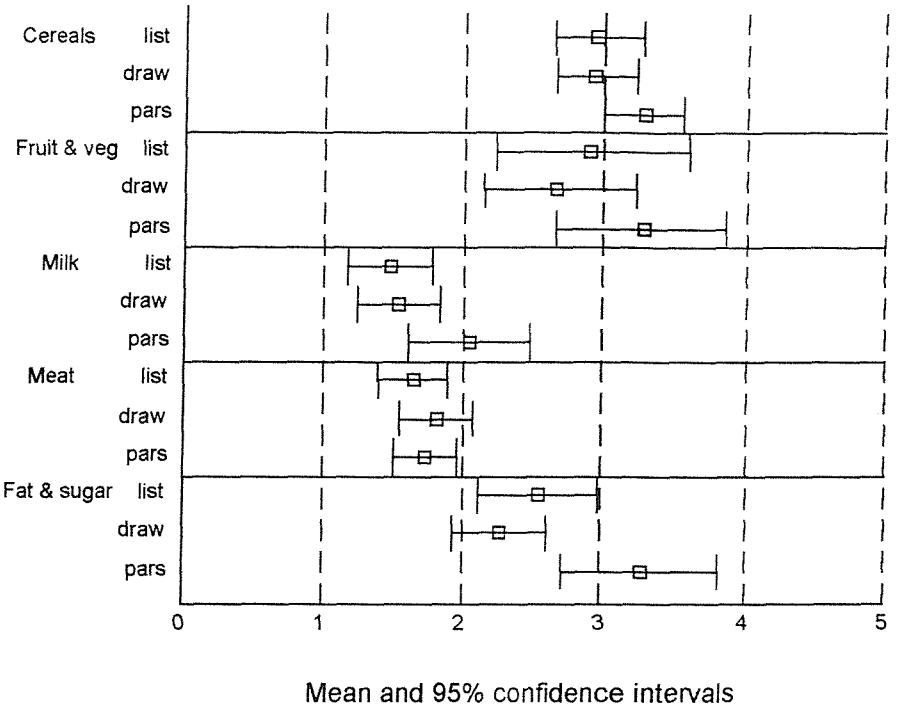
c) Reported by Parents

Food Group	Mean	SD	Min	Max
Cereals	3.27	0.92	2.0	5.0
Fruit and vegetables	3.26	2.05	0.0	9.0
Milk	2.04	1.50	0.0	7.0
Meat	1.73	0.78	0.0	4.0
Fat and Sugar	3.27	1.87	0.0	8.3

There was general under-reporting by the children, except for the meat, fish and alternatives food group. This may be because meat, fish and alternatives form the main part of a meal and therefore it is recalled more accurately.

Figure 24 shows the mean portions and 95% confidence intervals by food group for the children's lists and drawings, and their parent's reports.

Figure 24: Mean Portions and 95% confidence intervals for 24-hour recalls listed (list) and drawn (draw) by children, and 24-hour record reported by parents (pars).



Using Spearman's Rank correlation to compare each child's list with their drawing, it was found that the correlation for all the food groups was highly significant. There was also significant correlation between the children's lists and drawings and what their parents reported (Table 33).

Table 33: Correlation by food groups between 24-hour recalls and parental reports.

Food Group	listed : drawn	listed : parents	drawn : parents
cereals	0.75*	0.64*	0.77*
fruit and vegetables	0.88*	0.48*	0.57*
milk	0.77*	0.67*	0.59*
meat	0.87*	0.60*	0.66*
fat and sugar	0.73*	0.34†	0.31†

*$p<0.001$ †$p<0.05$

In the cereal group the children tended to under-report their consumption of potatoes and bread. In the fat and sugar group the children under-reported cakes,

biscuits, desserts and drinks. Table 34 lists the mean differences and levels of significance, calculated using a paired t-test, between a) what the children listed and what they drew, b) what they drew and their parent's reports, and c) what they listed and their parental report.

Table 34: Mean Paired Differences between the number of portions of foods for Listed and Drawn 24 hour recalls and the Log Sheet completed by the Parents

a) Children's list compared to their drawing

listed : drawn	mean difference	s.e.	t-value	*p* value
cereals	0.01	0.10	0.10	0.92
fruit and vegetables	0.23	0.16	1.39	0.17
milk	-0.06	0.10	-0.62	0.54
meat	-0.17	0.06	-2.69	0.01*
fat and sugar	0.28	0.15	1.79	0.08

b) Children's drawing compared to parental report

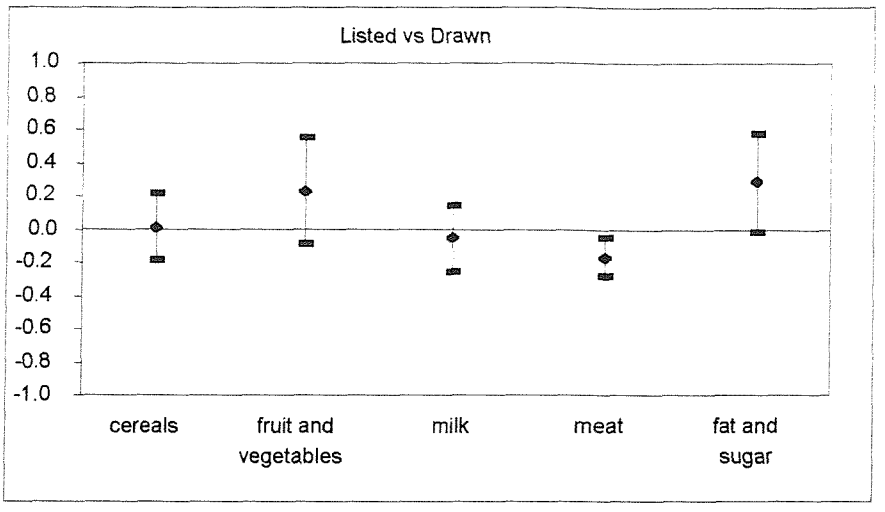
drawn : parents	mean difference	s.e.	t-value	*p* value
cereals	-0.32	0.10	-3.37	0.002*
fruit and vegetables	-0.58	0.23	-2.59	0.01*
milk	-0.51	0.19	-2.69	0.01*
meat	0.08	0.10	0.81	0.43
fat and sugar	-1.00	0.28	-3.59	0.001*

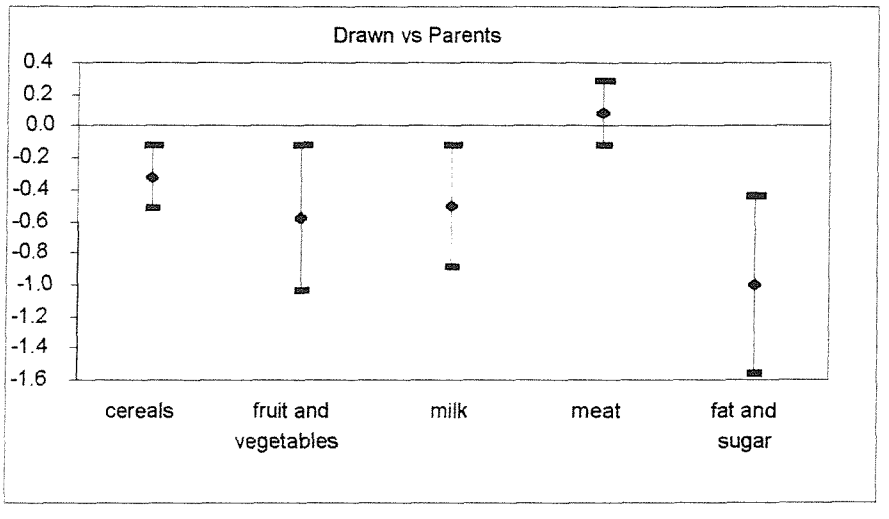
c) Children's list compared to parental report

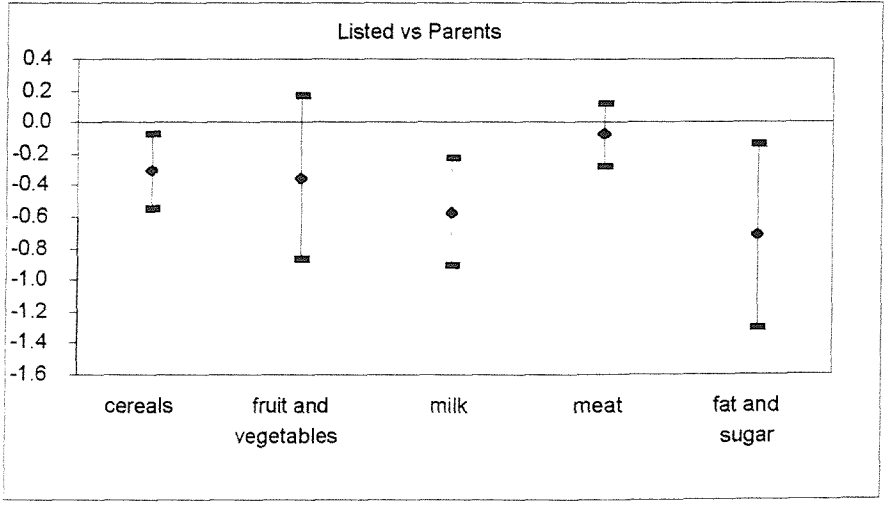
listed : parents	mean difference	s.e.	t-value	*p* value
cereals	-0.31	0.12	-2.57	0.01*
fruit and vegetables	-0.35	0.26	-1.35	0.18
milk	-0.57	0.17	-3.37	0.002*
meat	-0.08	0.10	-0.81	0.43
fat and sugar	-0.72	0.29	-2.49	0.02*

The mean differences and 95% confidence intervals are shown in Figure 25, page 135.

Figure 25: 24 hour recalls by 9 to 10 year-old children listed and drawn, and their intakes as reported by parents (mean difference and 95% c.i.)







For bread, cereal and potatoes, fruit and vegetables, milk and milk products and the fatty and sugary food group the children reported similar foods whether they listed or drew it. However, they reported significantly fewer portions of meat, fish and alternatives when they recalled their diet using the list method than when they drew their 24-hour recalls; this was regardless of whether children listed or drew their recalls first. This may be a spurious result but would be worthy of further investigation with a larger sample size.

Compared to that reported by the parents, the children tended to under-report bread, cereals and potatoes, milk and milk products and fatty and sugary foods.

At the population level, comparing the proportions from each of the food groups by recall method and parental report, there was no significant difference in the proportions of any of the 'Balance of Good Health' food groups except the meat, fish and alternatives group. The average of the children's list and draw recalls were compared to parental reports using a t-test (Table 35). The *p* values ranged from 0.21 for meat, fish and alternatives to 0.88 for fruit and vegetables.

Table 35: Proportions of reported foods by 'Balance of Good Health' food groups

Food Group	Listed (%)	Drawn (%)	Parents (%)	*p* value*
Cereals	26.7	27.0	25.1	0.30
Fruit and vegetables	22.9	22.5	23.1	0.88
Milk	13.0	13.7	15.0	0.41
Meat	15.2	16.9	13.8	0.21
Fat and sugar	22.2	20.1	23.0	0.40

*2-tailed t-test

5.2.2.3 Discussion

With the exception of the meat, fish and alternatives and fruit and vegetables food groups, the children generally under-reported their intake relative to parents. There did not appear to be systematic under-reporting by food group. In a small study of 24 children (grades 3-6), Baranowski *et al.* found that when children recalled their diet at the end of the day they had a tendency to under-report their food consumption (Baranowski *et al.*, 1986). No specific pattern was detected among the food groups. Van Horn *et al.* found that for most groups of foods, 9 year old children and their parents reported similar frequencies but different portion sizes (Van Horn *et al.*, 1990).

The children tended not to report whether the food was a lower fat or sugar variety. If we are to use the data collected to measure change in dietary patterns, we will need to have information on any changes within a food group. Therefore we need to know if prepubescent children are capable of providing this information.

Using the percentage of foods by food group, rather than the actual number of foods reported, a similar picture was seen for children compared to their parents. At a population level, a 24-hour recall may be a reliable method of identifying the balance of foods.

Comparing the two recall methods, it would appear that drawing a 24-hour recall did not enhance the ability of the children to remember what they had eaten. The pictorial method provided more descriptive data than the list and the children found the drawing exercise fun to do. However, these advantages have to be weighed against the increased time taken to complete the task. Also, although conducting studies in the classroom situation has the advantage of a 'captive audience', it is difficult to prevent interaction between the children. With the increased time needed to complete a pictorial recall, there is more time for interaction and the greater possibility that children may be influenced by their neighbour. It would therefore, to be more advantageous for this age group to use a food recall list based around meal times.

Summary findings

There was no difference in the ability of children to recall their diet whether written or drawn. The advantages of the drawing method were that it provided more descriptive information and the children enjoyed completing the task. The disadvantages were the increased time involved in carrying out the task and the greater time for pupil interaction which may influence their output.

The list method for 24-hour recalls would be preferable in this age group.

5.3 Development of Food Diaries

The second method investigated by this project that may be suitably adapted for use with a prepubescent population was food diaries. The use of a food diary for prepubescent children has the advantage that, as it is a prospective method, it does not rely on memory.

5.3.1 Preliminary Studies

From the information gathered during the discussion group sessions, 'food diaries' were produced in the format of one page per day. Each day was divided into the usual meal and snack times; breakfast, mid-morning, lunch, on the way home from school, at home but before the evening meal, evening meal, and before bed. As the information collected was to be used as part of the children's nutrition education lessons the data was analysed using the simple food group database.

5.3.1.1 Method

Thirty-one 'Y5-95' schoolchildren were asked to record everything they ate for five consecutive school days (Dataset 14). The children were asked to describe and record all foods and drinks and the time they were consumed. The descriptions were mainly limited to generic dishes rather than their component parts and no weights were recorded. The children's class teacher checked the

diaries after the first day and offered them help if they needed it. The diaries were analysed using the simple food group database as described in Chapter 3, Section 3.4.

5.3.1.2 Results

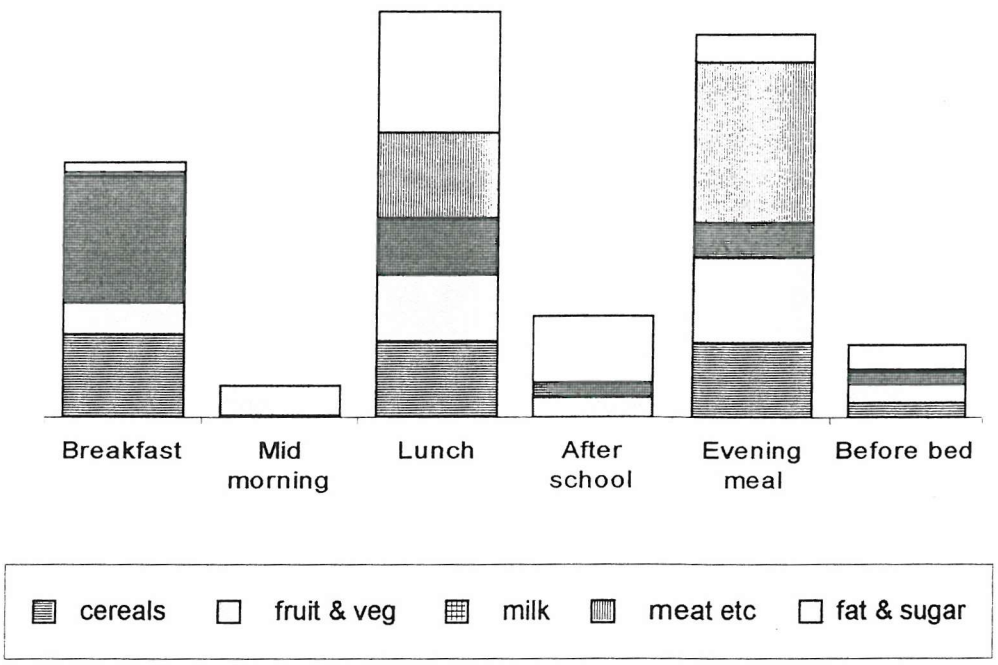
Of the 16 girls and 15 boys who took part in the study 1 girl and 2 boys (9.7%) did not return diaries. Of those returning food diaries, 1 girl and 3 boys (12.9%) returned incomplete diaries (i.e. three or less days) and these were excluded from the analysis. 14 girls (87.5%) and 9 boys (60.0%) returned completed diaries. This was an overall response rate of 74.2%. Table 36 shows the proportional breakdown of the foods eaten by the 23 children who completed the 5-day record.

Table 36: Five-day records by food group for twenty-three 'Y5-95' children

Food group	Percentage of times food group listed
Bread, cereals and potatoes	27.8
Fruit and vegetables	17.6
Milk and dairy products	16.0
Meat, fish and alternatives	14.4
Fatty and sugary foods	24.4

The food diaries, analysed using simple food group database, show that there was a high consumption of fatty foods (e.g. crisps) and sugary foods (e.g. cakes, biscuits) in this age group of children. Looking at the food patterns across the different times of day, (Figure 26), it can be seen that more than 40% of the fatty and sugary foods were eaten at lunchtime. Many of the children had packed lunches which included savoury snacks and biscuits or cake. This was also found in the observational study. Nearly 50% of the milk and dairy produce was consumed at breakfast time, mainly as milk on cereal. Forty-three percent of the cereal, bread and potatoes group was consumed at breakfast time, as cereal (28%) or toast (15%).

Figure 26: The proportion of total food intake by food group and meal category



Twenty-two percent of the children ate fruit mid-morning on three or more days. A further 26% ate fruit on one or two days of the 5-day record. The school has a policy of allowing only fruit to be eaten at morning break, hence the high proportion of the fruit and vegetable group consumed at that time. This may not to be representative of the general population of prepubescent children. A US study of 360 primary school children found that 41% of them had a mid-morning snack on three or more days a week, of which 40% was fruit (Cross *et al.*, 1994). Ruxton *et al.* found that, of 136 Scottish 7 to 8-year-olds, 58% had fruit as a snack at least once a week. However, the snack time was not mentioned. (Ruxton *et al.*, 1996a)

Table 37 shows each meal time divided into the five food groups. The food pattern for breakfast mainly consisted of foods from the cereals and milk groups reflecting the large proportion of ready-to-eat breakfast cereals consumed by this age group. A large proportion of the foods eaten at lunchtime came from the fatty and sugary foods group. These were mainly savoury snacks such as crisps, sweet biscuits, cakes and sugary drinks. Savoury snacks, biscuits and cakes were popular as a snack after school, whereas before going to bed many of the children had a bowl of cereal.

Table 37: Percentage of meal or snack period by food group

	Breakfast (%)	Mid morning (%)	Lunch (%)	After school (%)	Evening meal (%)	Before bed (%)
Cereals, bread, potatoes	44.1	9.6	25.2	0.9	29.1	25.7
Fruit and vegetables	11.5	89.7	14.2	15.3	22.2	20.3
Milk and dairy products	39.1	0.0	10.8	11.1	7.9	14.3
Meat, fish, alternatives	0.8	0.0	13.7	0.0	31.0	0.6
Fatty and sugary foods	4.5	0.6	36.1	72.8	9.8	39.1
Total no. of portions	*270*	*31*	*440*	*118*	*370*	*84*

Taking the group as a whole, the average number of portions of food per day from each food group is shown in Table 38. The largest number of portions consumed came from the bread, cereal and potatoes group (average of 3.3 portions per day). The average consumption of two portions of fruit and vegetables per day is considered well below the recommended 5 portions per day. However, the food group portion database, does not take account of small amounts of fruit or vegetables in mixed dishes. This may increase the fruit and vegetable portions slightly but there remains general under-consumption of fruit and vegetables. This data may be used as feedback to children to help them alter the balance of their food groups by, for example, replacing one or more of the foods in the fatty and sugary foods group with something from the fruit and vegetables group.

Table 38: The average daily portions of each food group per day for the class as a whole.

Food group	Average number of portions per child per day
Bread, cereals and potatoes	3.3
Fruit and vegetables	2.0
Milk and dairy products	1.8
Meat, fish and alternatives	1.7
Fatty and sugary foods	2.8

5.3.1.3 Discussion

The food diaries appeared to have been completed by the children themselves, although the extent of parental involvement could not be established. With an overall response rate of over 74% for completed diaries, this clearly could be a feasible method for collecting dietary information from children. There is, however, the issue of bias if the non-responders or those with incomplete records, have a different diet from that of the responders. Furthermore, the quality of the data needs to be established. Berg *et al.* in a study of 7-day records in 11 to 15 - year-olds, found that the drop out rates were lower among the younger children (17% compared to 51% in the older children) (Berg *et al.*, 1998). They found that, irrespective of age, the drop out rate was higher among boys, children from non-nuclear families, and those who spent more than 4 hours a day watching television or video. They also found those who dropped out of the study were less likely to eat breakfast and more likely to drink whole milk. This suggests that dietary information from the remaining children may not be representative of the population as a whole. The implications of these points are examined in Section 5.4, 'The Reliability of Children's Records'.

Generally, the standard of recording fell towards the end of the recording period. Participant fatigue is a problem that may be overcome by reducing the number of recording days, provided it can be shown that this gives a similar overall result. The study by Berg *et al.* found that towards the end of the week fewer foods were recorded and there was an increase in the number of non-recorded days (Berg *et al.*, 1998). Daily support and reinforcement may improve the response rate and the overall quality of the diaries from prepubescent children.

The information was fed back to the class by the researcher as part of their nutrition education lessons. Coloured pie charts were used; these were in a similar format to the 'Balance of Good Health' plate. It was found that the children could relate to the information in that format and that they understood the concept of increasing foods in one group and decreasing them in another in order to change the proportions of the pie chart. The teacher found the information a useful addition to the nutrition education curriculum.

Summary finding

It is recognised that food group categorisation using the simple food group database is somewhat simplistic. As a large number of fatty and sugary foods will contain complex carbohydrates, the analysis is likely to overestimate the portions of fat and sugar eaten while not taking full account of the portions of cereals. The effect of this is to overemphasis the fatty and sugary foods group and to underestimate the bread, cereal and potatoes group. However, an advantage of this technique is that it is relatively quick and easy to use and the children easily understood the concept.

5.3.2 Development of a 4-day Food Diary

As a result of the 5-day diary study, it was considered that 4-day diaries would be as much as the children could complete before their attention to detail diminished. Nevertheless, 4-day records still provide sufficient information to analyse the data at the population level. It is well established that eating habits on weekend days differ from weekdays (Nicklas *et al.*, 1997; Post *et al.*, 1987; Thompson *et al.*, 1986). Therefore, a weekend day was included in the recording period. Preliminary studies indicated that daily support from the researcher might increase compliance and reduce participant fatigue.

During the autumn term of academic year 1996/7, two 'Y5-96' classes of 9 to 10-year-olds were recruited into the study. At the beginning of the academic year the researcher attended the classes to talk about the project and to get to know the children. A quick draw and tell session was arranged to familiarise the children with some of the work that they would be doing. A brief letter was sent home to the parents to tell them about the impending work and to ask if they would be willing to take part in the exercise (Appendices E and F).

5.3.2.1 Method

Fifty-four 'Y5-96' pupils from the same two classes that did the food type questionnaire were asked to take part in a food survey. Twenty-four of the children and their parents volunteered to complete 4-day weighed records. These were to be used to compare to the food diaries (see Section 0). The remaining thirty children were to be included in the recording of food diaries. However, one boy and two girls were absent during the study period and did not take part. This left 27 children available to complete food diaries (Dataset 15). (The weighed record group formed Dataset 4).

The Dataset 15 children were asked to complete a 4-day unweighed food diary. As with the preliminary studies, the diary was divided into the usual meal and snack time periods for each day, i.e. breakfast, mid-morning, lunch, on the way home from school, at home but before the evening meal, evening meal, and before bed. The children were asked to describe and record all foods and drinks in detail along with the time they ate or drank them.

The two classes (A and B) were allocated to different recording periods. Class A began recording on a Wednesday and finished the following Saturday. Class B recorded their diet from the Sunday through to the following Wednesday. Each class completed their diaries on the same days as those keeping weighed records. On the day before class A began their records, and on the Friday before class B began theirs, the researcher went to the school and explained to the children filling out the food diary exactly what they had to do and to answer any queries they had. The researcher returned to the school each morning to check the diaries and answer questions.

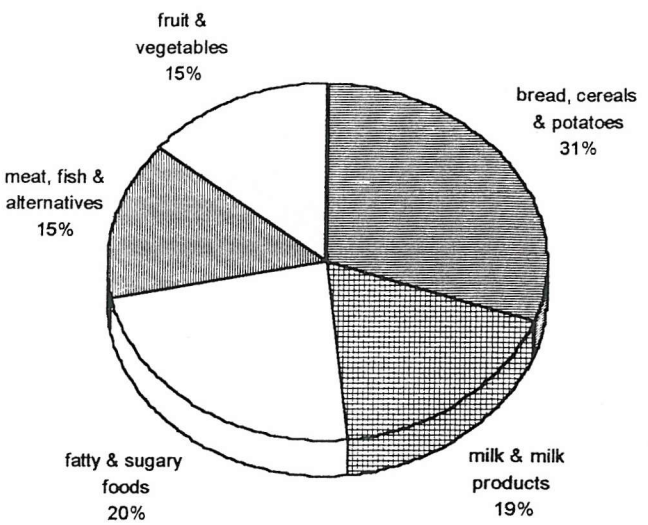
The diaries were analysed using the simple food group database, i.e. according to the number of portions of food in each of the 'Balance of Good Health' five food groups, fruit and vegetables; bread, cereals and potatoes; milk and milk products; meat, fish and alternatives; fatty and sugary foods, irrespective of actual portion size.

5.3.2.2 Results

Twenty children (74%) completed three or more days (including a weekend day), of their food diaries and these were included in the analysis.

The average proportion of foods in each of the five food groups is shown in Figure 27. Using the simplified database there would appear to be too little fruit and vegetables and too many foods from the fatty and sugary group compared to the 'Balance of Good Health' guidelines.

Figure 27: The proportion of foods by food group for the children completing food diaries.



The average number of portions consumed from the bread, cereals and potatoes group was three and a half, but ranged from 2.3 to just over five portions a day over the 4-day recording period. The mean intake of fruit and vegetables was just over one and a half portions per day, with a range from half a portion to three and a half portions. Only five children (25%) reported an average of 2 or more portions of fruit or vegetables per day. This is substantially fewer than the 5 or more portions currently recommended. Average consumption of milk and milk products was just over 2 portions and varied from a 0.3 to 4 portions per day. Just over one and a half portions of meat, fish or an alternative were eaten on average varying from 0.7 to 2.5 per day. The consumption of fatty and sugary foods varied from less than 1 portion per day to over 6 portions. On average the children had more than portions two of fatty or sugary foods a day.

Table 39: Average number of portions per day by food group

Food Group	mean	min	max
Bread, cereals and potatoes	3.5	2.3	5.3
Fruit and vegetables	1.8	0.6	3.6
Milk and milk products	2.2	0.3	4.0
Meat, fish and alternatives	1.7	0.7	2.5
Fat and sugar	2.3	0.7	6.1

The resulting proportions by food group from the 4-day diaries were similar to the findings of the 5-day diaries carried out during the preliminary phase. Looking at the number of portions, there were no significant differences between the two groups of pupils using a two-tailed t-test (Table 40).

Table 40: Average number of portions per day by food group: 5-day food diaries compared to 4-day diaries

Food Group	5-day food diaries mean no. portions	4-day food diaries mean no. portions	*p* value*
Bread, cereals and potatoes	3.3	3.5	0.46
Fruit and vegetables	2.0	1.8	0.51
Milk and milk products	1.8	2.2	0.28
Meat, fish and alternatives	1.7	1.7	0.94
Fat and sugar	2.8	2.3	0.23

* 2-tailed t-test

5.3.2.3 Discussion

The 74% overall response rate for the 4-day diaries was the same as that for the 5-day diaries collected during the preliminary stage. This would suggest that the presence of the researcher was no more advantageous than support from the teacher. If this is a true finding, then using the teacher would reduce the time and expense of data collection.

There was a non-significant decrease in the number of foods recorded between day one and day four. The dilemma between recording sufficient days to estimate usual eating habits and the fact that the number of foods recorded tends to decrease over time is well known (Berg *et al.*, 1998; Carroll *et al.*, 1997; Willett, 1990).

The 4-day diaries analysed using the simple food group database suggest that, on average, the children had just under two portions of fruit or vegetables each a day. There was wide interpersonal variation although the intrapersonal variation was less marked. Other studies have found the reverse scenario with greater intrapersonal than interpersonal variation (Beaton *et al.*, 1979; McNeill *et al.*,

1991). This may result from the short-term nature of this study, which only covered four days and did not take account of seasonal variations.

None of the twenty children reported eating five or more portions of fruit or vegetables per day. A US study found that only 1 in 5 children ate five or more portions of fruit and vegetables a day (Krebs-Smith *et al.*, 1996). However, the US fruit and vegetable group includes potatoes which would increase the proportion of children eating the recommended number of portions of fruit or vegetables a day.

The high consumption of fatty and sugary foods found this study is similar to findings from other studies of similar age groups (Anderson *et al.*, 1994; Kennedy and Goldberg, 1995; Wolfe and Campbell, 1993). The Survey of British School children found that the major sources of energy in their diet were bread, chips, milk, biscuits, meat products, cakes and puddings, and that these accounted for nearly fifty percent of total energy intake (Department of Health and Social Security, 1989). The study also found that, on average, 10 to 11-year-old children derived more than 37% of their energy from fat.

In order to assess whether the diaries were a good measure of consumption patterns by food group, they were compared to the weighed dietary records completed by other children from the same study group. This is discussed in detail in Section 0.

Summary findings

Even allowing for the different days of the week and number of days recorded, the analysis by food groups of the 5-day and 4-day diaries was very similar, suggesting that the method is consistent in this population.

Food diaries have the advantage of being relatively easy to complete and give a better representation of current eating habits than a 24-hour recall. Disadvantages include the increased time and expense incurred in processing data and the possible bias due the decrease in the number of foods recorded with time. These advantages and disadvantages are not specific to prepubescent children; they have also been found in studies in older children and adults.

5.4 The Reliability of Children's Records

To establish the reliability of food records kept by prepubescent children an investigation was set up to compare children's food diaries with information from their parents.

5.4.1 Method

Two 'Y5-97' classes of 9 to 10-year-olds were asked to keep a record of everything they ate and drank from the time they got up in the morning until they went to bed that night (Dataset 16). The children were given a food diary, divided into sections as previously described. It was explained that it was important to record all foods including drinks, sweets and savoury snacks. The children were asked to make a note of the types of foods they ate (e.g. low fat) and the cooking method. The children made notes on the front of the food diary to remind themselves to include details on the fat and sugar content of the foods they ate. For example, was milk whole, semi-skimmed or skimmed; was the fat spread they used butter, margarine or low fat spread; did they drink pure fruit juice or fruit squash; did they have sugar on their cereal or in tea or coffee; if they had chips, were they oven-baked, deep-fried at home or bought from the chip shop; were burgers, fish fingers, etc. fried or grilled?

Prior to the experiment, a letter and an accompanying log-sheet had been sent to the parents. The parents were asked to record everything their child ate on the same day as their child kept the food diary. They were asked to record their child's intake without the child being aware. It was also stressed that they should not worry if they were unsure of anything that had been eaten outside of the home, but simply that they should note that the child was out and record what they could. The parents were also asked to complete the same food type questionnaire as used in the nutrition knowledge assessment studies and return it, together with the log sheet, sealed in the envelope provided. The food type questionnaire was used to enhance the information provided by the children.

On the first morning of the study the researcher went along to the two classes to review what had been recorded for breakfast and to answer any queries the children had. The children were reminded immediately before lunch to write in their diaries everything they ate at lunchtime. A note was then made of all foods

that were available for school lunch that day and what was for sale from the snack bar. Seven children had a cooked school meal and this was noted without the children's knowledge. At this point in the project, the children were accustomed to the researcher being around the school and took little notice of her presence.

The children's food records and parental log-sheets were analysed by food group, with no account taken of portion size or leftovers.

5.4.2 Results

On the day of the study, four children were absent. Of the remaining 53 children, seven parents did not return the log-sheet and six children did not complete the food record. In all, forty complete sets of data were obtained from the two classes. This was a response rate of 75%. The information provided by the parents was assumed to be the truth.

From the number of food items recorded, it was apparent that the children generally recorded fewer food items than their parents. On average the children recorded approximately 95% of the foods logged by the parents (Table 41). Milk and milk products and meat, fish and alternatives were most accurately recorded and fruit and vegetables most frequently omitted.

Table 41: Average number of food portions, by food group, recorded by the children and their parents

	Children	Parents	% reported by children
Cereals	3.5	3.5	98.2
Fruit and vegetables	2.3	2.5	89.1
Milk and milk products	2.0	1.9	100.9
Meat, fish, alternatives	1.8	1.8	96.9
Fat and sugar group	3.0	3.3	92.0

However, using the paired difference t-test there were no significant differences between the parent's logs and the children's records within any of the five food groups. The correlations between the logs and the records were highly significant

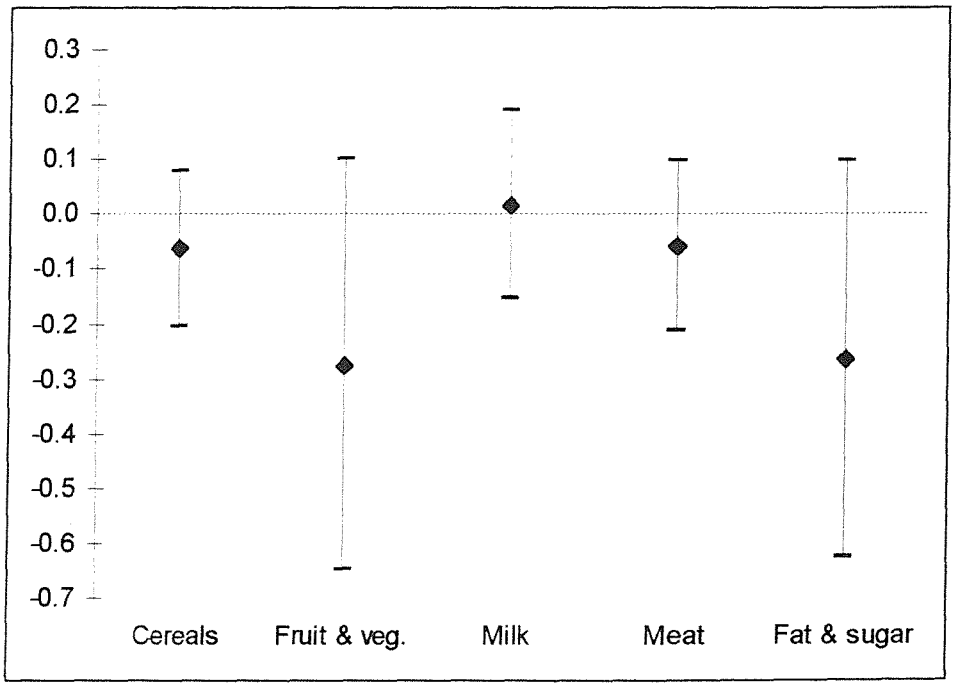
($p<0.0001$) and ranged from r=0.92 for milk and milk products to r=0.73 for fruit and vegetables (Table 42).

Table 42: Paired difference and correlation (r) between the number of foods, by food group, recorded by the children and those reported by parents.

Food Group	Mean difference	Standard deviation	*t*-statistic	*p*-value	r
Cereals	-6.25×10^{-2}	0.44	-0.89	0.38	0.86
Fruit and vegetables	-0.28	1.17	-1.49	0.15	0.73
Milk and milk products	1.68×10^{-2}	0.53	0.20	0.84	0.92
Meat, fish, alternatives	-5.75×10^{-2}	0.49	-0.75	0.46	0.83
Fat and sugar group	-0.27	1.13	-1.49	0.15	0.77

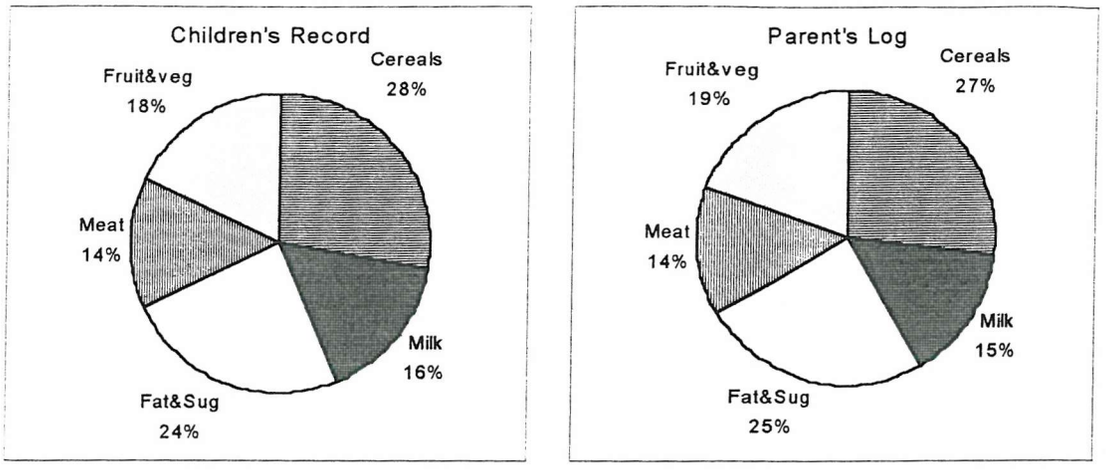
The figure below shows the mean difference and 95% confidence interval by food group.

Figure 28: The average difference and 95% confidence interval between number portions reported by parents and those recorded by the children



Examining the overall proportion of foods by food group showed there was no significant difference between the balance of food groups recorded by the children and that recorded by the parents (Figure 29).

Figure 29: Proportion of foods by food group for children's records and parent's log-sheet.

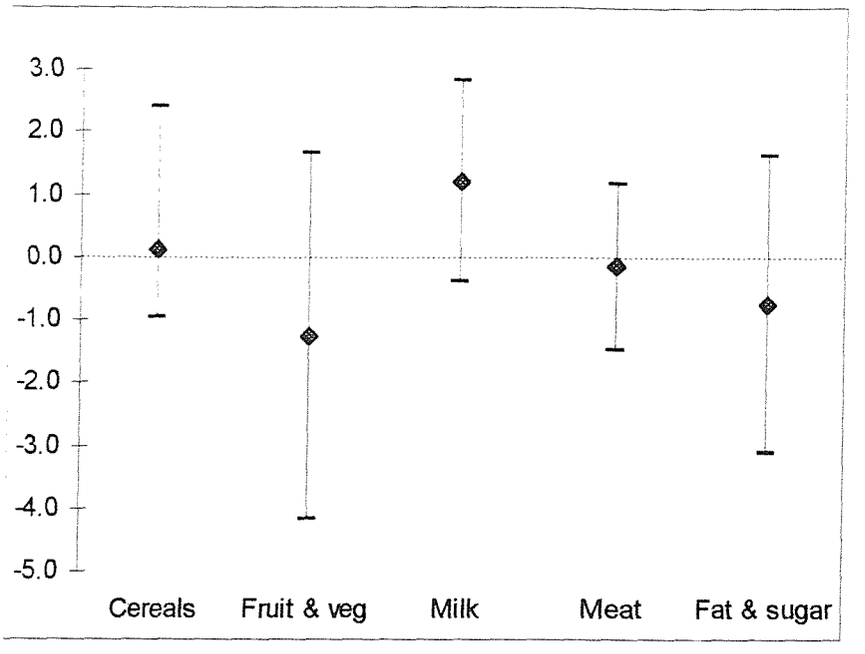


The deviations around the mean paired differences of proportions were greater than, but not significantly different from, the deviations around the mean paired differences of the number of portions (Figure 30). The correlation coefficients ranged from r=0.71 for the cereal group to r=0.88 for the milk group (Table 43).

Table 43: Paired difference and correlation (r) between the percentage of foods, by food group, recorded by the children and those reported by parents.

Food Group	Mean difference	Standard deviation	*t*-statistic	*p*-value	r
Cereals	0.13	5.97	0.98	0.33	0.77
Fruit and vegetables	-1.25	9.14	-0.87	0.39	0.69
Milk and milk products	1.21	4.98	1.54	0.13	0.83
Meat, fish, alternatives	-0.15	4.18	-0.22	0.83	0.81
Fat and sugar group	-0.74	7.38	-0.63	0.83	0.80

Figure 30: The average difference between the proportion of foods reported by parents and those recorded by the children, by food group (mean and 95% confidence interval)



5.4.3 Discussion

At the food group level, the information provided by the children was not statistically different from that reported by their parents. However, some of the detailed descriptions given by the children differed from those of their parents. For example, children sometimes recorded a different vegetable than their parent, or recorded "roast meat" where the parent reported "roast lamb".

At the simplest level, children were capable of recording their diet with relative accuracy. At the population level, children's records produced a similar picture to that reported by parents. In general, children were less descriptive about their foods than their parents. However, drawings could be used to enhance the detail.

The greatest variation between children's records and those of their parents was in the number of portions of fruit and vegetables; the children, on average, reported almost 11% less fruit and vegetables than their parents. Parents frequently listed

fruit at 'snack' times such as mid-morning. It could be that children forgot to complete their record more often at 'snack' times. It may also be that parents, being aware of the health messages about eating more fruit and vegetables, listed fruit and vegetables that their child did not have. Another explanation could be that the parents listed the foods they gave to their child but the child did not actually eat them and so they did not record them. It was not possible to establish whether the difference in recording of fruit and vegetables was under-reporting by the children or over-reporting by the parents.

In a study of fourth and fifth grade students by Domel *et al.* children's records of their lunch were compared to observation (Domel *et al.*, 1994a). It was found that the correlation between the observed intake and the children's food record ranged from 0.85 for dessert to 0.16 for grain (rice or pasta). Domel *et al.* found that all the meal components, other than grain, were significantly correlated. Fruit and vegetables had a correlation of 0.83. The researchers noted, however, that the high correlation may be partly due to the fact that a copy of the school lunch menu was usually in the classroom. Also, as the records were completed immediately after lunch, they may have had help from other class members or the teacher.

A study examining the feasibility and acceptability of food records by 9 to 13 year old children found that the majority enjoyed completing the records and that it was not too difficult (Gillman *et al.*, 1994). With this method, foods were recorded when they were eaten, or shortly after, and it did not rely on the child's memory. The biggest problem encountered by the children was remembering to complete their record every time they ate something.

Crawford in a study of 9 to 10 year old girls found that a 3-day record compared to observation produced a greater accuracy than either a 24 hour recall or a 5-day food frequency questionnaire (Crawford *et al.*, 1994). The food record had no systematic bias and there was no significant difference with a paired *t* test. The food record method had fewer missing foods (25% compared to 46% for the 5-day FFQ) and fewer phantom foods (10% compared to 40% for the 5-day FFQ). No mention was made of participant fatigue.

The problem of participant fatigue among the prepubescent children noted during the 4-day and 5-day diary studies could be improved if several 1-day records were

collected on non-consecutive days. The relative accuracy of a single day's record indicates that this would be suitable for children of this age to provide a representative balance of food groups.

One of the disadvantages of the food diary method is that children (or their parents) may alter their diet during the recording period. This would mean that the information would not be representative of usual intake.

Summary finding

Children recorded their diet with relative accuracy compared to parental information, but the detail provided by children was less descriptive than that of parents. The use of a single day's food record would be a feasible way to collect dietary information from prepubescent children. Several single day records completed over a few weeks may give a better picture of the eating habits of prepubescent children than a diary recording several consecutive days.

The results of this study indicate that a single day's diary data, enhanced by a food type questionnaire completed by the parents, produces consistent and reliable information on the balance of prepubescent children's diets using the simplified food group database.

5.5 Comparison of Food Diaries with Reference Standard

Section 5.5.1 describes the methodology used for the weighed records which were used as a reference standard. Section 5.5.2 summarises the demographic and anthropometric data collected in order to assess if any biases exist between the children who completed food diaries, those who completed weighed records and those who did not participate. Section 0 compares the food diaries with the reference standard.

5.5.1 Reference Standard for Comparison: Weighed Records

The purpose of this part of the study was to compare the use of 4-day food diaries with a reference standard. Weighed records were chosen as the reference measure to compare with the food patterns of the food diaries. As the food diaries and weighed records were carried out prospectively over the same time period, it was expected that any bias due to conscious or unconscious alteration of usual diet would be similar in both groups of children.

5.5.1.1 Methods

The two 'Y5-96' classes of 9 to 10-year-old children and their parents were invited to participate in this exercise. Twenty-four children (15 girls, 9 boys) and their parents agreed to complete a 4-day weighed record which included one weekend day (Dataset 4). These children carried out the weighed records over the same time period as the children who kept a 4-day food diary.

The parents and children who volunteered to complete weighed records were invited to a meeting to learn more about the project and to receive instructions on using the scales and completing the record. The parents were asked to help the child with the weighing and recording over the four days. It was the intention of the researcher that the children would be actively involved in the measuring and recording but for reasons of accuracy, it was considered better if this was overseen by the parent.

Each child was then given a set of Soehnle digital weighing scales that weighed to the nearest gram, and a book in which to record everything they ate or drank over

the four day study period. The children and parents were asked to describe the food in as much detail as possible, for example:

type cod, not just fish
number of items e.g. 2 slices of wholemeal bread
method of cooking e.g. boiled, grilled, baked, fried
combination dishes such as stews, state ingredients if possible.

All leftover foods were to be weighed and recorded. The children were asked to note everything they ate outside the home and where possible to give a weight or the size of the food eaten. Instructions were also written down and given out with the scales and record book.

The two classes were allocated to different recording periods. Class A recorded their diet from Wednesday through to Saturday and class B from Sunday to the following Wednesday. Each class followed the same time schedule as the 4-day diaries. On the day before class A began their records the researcher went to the school and the children were shown, once again, how to use the scales and fill in their record books. Over the next three days the researcher went to the school each morning to check the records and to answer any questions the children had.

Children having packed lunches were asked to weigh the food before they went to school and to take home, where possible, anything they did not eat and to weigh the waste in the evening. Any foods swapped or discarded at school were to be noted in their records.

The school served a hot meal every lunchtime and had a snack bar from which the children could make purchases such as baked potatoes, sausage rolls, sandwiches, jelly, fruit, cakes and biscuits. Menus were obtained for all of the study days and several samples of each of the servings were taken to calculate a mean portion weight for each of the foods available. Children buying food at lunchtime were asked to note what they ate and, if they left anything, what they left. The mean food weights were then used to calculate the components of the weighed record for each of the children purchasing food at lunchtime.

On Friday class B was initiated into the study and reminded that they were to start recording their diet first thing on Sunday. Like class A, class B was followed up

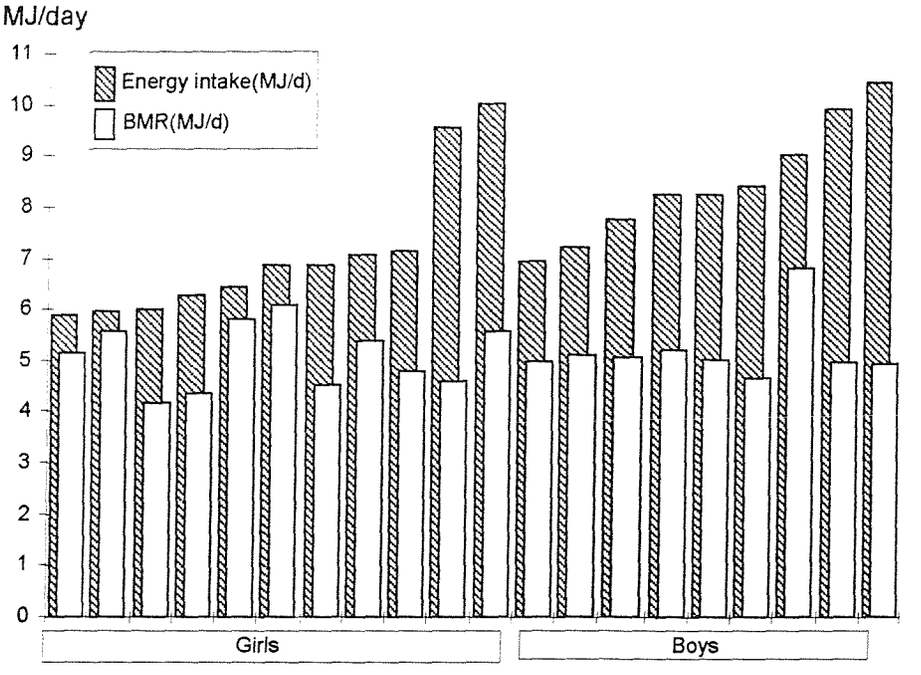
each morning and the weights of foods served at lunch times were estimated from samples.

The results were coded according to McCance and Widdowson Food Composition Tables (McCance and Widdowson, 1991), entered onto a computerised nutrient database, then verified. They were analysed for energy intake, the children's calculated energy intake being compared to their basal metabolic rate estimated by Henry *et al.* equation for 10 year olds (Henry *et al.*, 1999). The records were then analysed for fat, protein, carbohydrate, fibre, starch, sucrose, calcium, iron and vitamin C. Finally, the records were analysed according to the number of portions of food in each of the 'Balance of Good Health' categories; bread, cereals and potatoes, fruit and vegetables, milk and milk products, meat, fish and alternatives, and fatty and sugary foods. No account was taken of actual portion size and the foods were analysed using the simple food group database in the same way as the 4-day food diaries.

5.5.1.2 Results

Four weighed records were excluded from the analysis. One girl was ill during the period of the study, two girls completed less than 3 of the days and one girl had a reported energy intake less than her calculated BMR. This left 20 weighed records for further analysis. The mean energy intake for the group was 7.78 MJ/day (s.d. 1.46) (girls 7.15 (s.d. 1.41), boys 8.55 (s.d. 1.18)). Results for the girls and boys were significantly different using a two-tailed t-test (p=0.03). Figure 31 shows the comparison between the estimated basal metabolic rate and energy intake for the remaining 11 girls and 9 boys.

Figure 31: Comparison of estimated Basal Metabolic Rate (BMR) with Energy Intake calculated from the Weighed Records.



The twenty weighed records were analysed by food group using the simple food group database. The average number of portions eaten over the four days is shown in Table 44 below.

Table 44: Number of food portions over four days

	Weighed records			
	mean	s.d.	min.	max.
Bread, cereals and potatoes	15.3	3.0	9.0	20.0
Fruit and vegetables	10.6	5.1	4.5	22.5
Milk and milk products	10.6	4.3	2.3	18.0
Meat, fish and alternatives	6.1	1.5	4.0	9.0
Fat and sugar	12.9	5.4	0.6	22.4

On average the children had just under four portions of food from the bread, cereals and potatoes group per day but it ranged from 2.3 to 5 portions. There was an even larger variation in the number of portions of fruit and vegetables consumed, ranging from approximately one to five and a half. Milk and milk

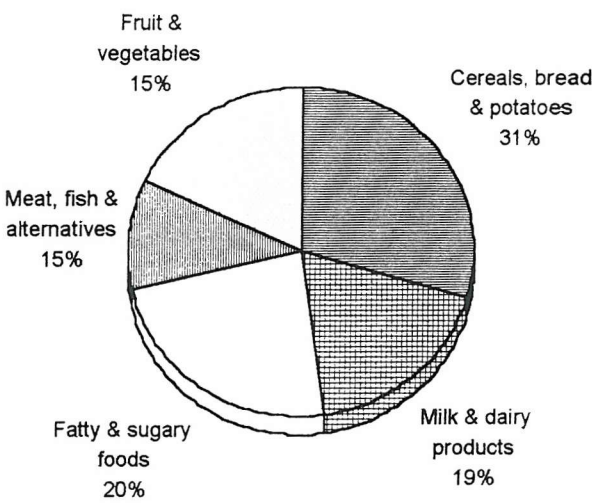
products varied from 0.8 to four and a half portions, meat, fish and alternatives from one to two and a quarter. The fat and sugar group varied from 0.2 to more than five and a half portions. The mean number of portions per day by food group is shown in Table 45.

Table 45: Average number of portions of food eaten per day by food group

Food Group	mean	min	max
Bread, cereals and potatoes	3.9	2.3	5.0
Fruit and vegetables	2.7	1.1	5.6
Milk and milk products	2.7	0.8	4.5
Meat, fish and alternatives	1.6	1.0	2.3
Fat and sugar	3.2	0.2	5.6

The results were also expressed as proportions. These are shown in Figure 32 below.

Figure 32: Proportion of foods by food group



5.5.1.3 Discussion

The ratios of energy intake to BMR of the children in this study ranged from 1.1 to 2.1 in girls and 1.3 to 2.1 in boys. It is usual to take 1.2 times the BMR as the minimum energy requirement and to exclude people whose recorded energy is less than this figure (Bingham and Nelson, 1991). Thirty-six percent of the girls in the study fell below this figure. However, there are differences of opinion regarding the accuracy of equations to estimate BMR or resting metabolic rate in prepubescent children (Bandini *et al.*, 1995; Firouzbakhsh *et al.*, 1993; Maffeis *et al.*, 1993; Wong *et al.*, 1996). Wong *et al.* concluded that some equations may be appropriate for use on a population base but are less useful at the individual level (Wong *et al.*, 1996).

In a study of 100 adults completing a 7-day weighed record, thirty-six percent of the subjects later admitted to under-reporting their intake, either because of "embarrassment" or because it was "too much hassle" (Macdiarmid and Blundell, 1997). Those who reported recording their diet accurately (54%) had a mean energy intake to BMR ratio (EI:BMR) of 1.23 (c.i. 1.13, 1.32). However, those who admitted to under-recording because it was inconvenient (16%) had a EI:BMR of 1.50 (c.i. 1.31, 1.69). It would appear that even among those who have an acceptable EI:BMR, there can be under-reporting.

It has been found that adolescents, particularly girls, under-report their food intake. However, studies of prepubescent children have found that their ability to record what they eat is somewhat better than older children (Bandini *et al.*, 1997; Baranowski *et al.*, 1986; Livingstone *et al.*, 1992). This may partly be due to the fact that parents are likely to be more involved in recording the diet of younger children.

The National Diet and Nutrition Survey (Office for National Statistics (Social Survey Division), 2000) found that the dietary records of 7 to 10 year olds recorded just over 90% of the children's estimated average energy requirement. The records were completed by, or with the help of, parents.

5.5.2 Demographic and Anthropometric Data

During the academic year 1996/7, demographic information and heights and weights were collected to determine if there were any differences between children completing food diaries, weighed records or non-participants.

5.5.2.1 Demographic details

5.5.2.1.1 Method

The two 'Y5-96' classes of 9 to 10 year old children were asked to fill in a form about themselves during class time. Permission to use the form was obtained from the school and the parent governors. A copy of the form is contained in Appendix G. The children were shown how to fill in the form and assistance was given as necessary. Fifty-four children (27 girls, 27 boys) completed the questionnaire, one girl and one boy were absent on the day the data were collected. Both of the absentees were children who completed food diaries.

The names and ages of the children were removed from the forms once a note had been made of which children returned them. The forms were then coded and analysed.

5.5.2.1.2 Results

Of the 57 children, two from the food diary group and three of the non-participants did not return a completed demographic questionnaire. Age, home, family and social class data were analysed for the remaining 52 children.

Age

The overall mean age was 9.98 ± 0.32. There was no difference in ages between those who completed weighed records, food diaries or returned no record (10.00 ± 0.37, 9.99 ± 0.26, 9.95 ± 0.33 respectively).

Home

All but one of the children said that they lived in a house or a bungalow. Over 70% of them said that their house was owned by their parents, two children lived in rented accommodation (one council, one private), but the remaining 25% of

children were unsure. Those children who did not return a food record were more likely to be unsure about the ownership of their home (Table 46).

Table 46: Home ownership by food record type

Home ownership	All Children (%) (n=52)	Weighed Record (%) (n=20)	Food Diary (%) (n=18)	None (%) (n=14)
Own	71.2	75.0	83.3	50.0
Rent	3.8	5.0		7.1
Don't know	25.0	20.0	16.7	42.9

Family

Table 47 shows the status of the children with respect to the adults in their household. Although the percentage of children in single parent families was greater in those completing food diaries than those completing weighed records, and greater still in those who did not participate, the numbers were too small to be considered statistically different. Almost a fifth of the children lived in a household with four or more children. There was also an increasing gradient of families with three or more siblings with weighed records being fewer than food diaries and those being fewer than non-participants.

Table 47: Parental and sibling status by record type

Family	All children (n=52)	Weighed Record (%) (n=20)	Food Diary (%) (n=18)	None (%) (n=14)
Single parent	17.3	10.0	16.7	28.6
Two adults	82.7	90.0	83.3	71.4
up to 2 siblings	80.8	90.0	77.8	71.4
3 or more siblings	19.2	10.0	22.2	28.6

Socio-economic grouping

Socio-economic groupings were determined from the occupation of the parents, as described by the children. If there were two adults working, the higher grouping was used (the traditional classification of the man as head of household was considered to be unrealistic). Of the 47 children who stated the occupation of their parents, those who did not participate were more likely to be from families of manual workers than those who completed food records.

Table 48: Parental occupation

Parental occupation	All children (%) (n=47)	Weighed Record (%) (n=18)	Food Diary (%) (n=16)	None (%) (n=13)
Non-manual workers	59.6	61.1	68.8	46.2
Manual workers*	40.4	38.9	31.2	53.8

* includes homemakers, unemployed and retired

5.5.2.1.3 Discussion

For all the demographic variables there was a greater similarity between the weighed record and food diary groups than those who did not participate.

The 1991 census data showed 61% home owner/occupiers in the Southampton area and 39% of adult (16 years or over) were economically inactive (Office of Population Census and Surveys, 1992a). In 1991 five percent of households in Southampton had 3 or more children under 16 years old (Office of Population Census and Surveys, 1992b).

However, it is not possible to relate the data found in this study to regional or national statistics as the denominators for the census data are not the same as those used here. The 1991 census data includes all households, whereas this study only includes households with children aged 9 to 10 years old.

5.5.2.2 Heights and Weights

Information on heights and weights was collected and used to validate the weighed records.

5.5.2.2.1 Method

Fifty-seven children in the two 'Y5-96' classes were potentially available for the study. Fifty-three of the children were weighed and measured, three girls and one boy being absent on the days the measurements were taken. One of the absentees was from the food diary group. Weights were taken with the children in their indoor clothing but without shoes, and measured to the nearest 100 grams using Soehnle electronic scales. Heights (in stocking feet) were measured to the nearest centimetre using an electronic stadiometer. The children were asked to stand on the stadiometer plate with arms by their sides, feet together with heels against a wooden marker attached to the plate, and the head in the Frankfurt plane. The measurement was taken by lowering the arm of the stadiometer gently onto the child's head.

Body Mass Index (BMI) in kg/m^2 was calculated for each child. Estimates of Basal Metabolic Rate (BMR) were calculated using recent data for 10-year-olds computed by Henry *et al.* (Henry *et al.*, 1999). These gave slightly lower rates for boys than using Schofields formula for 10 to 17-year-olds (Department of Health, 1991).

Table 49: Formula for the calculation of basal metabolic rate in 10-year-olds

Females	(wt(kg) * 49.0 + ht(cm) * 24.8) - 331
Males	(wt(kg) * 54.6 + ht(cm) * 18.8) + 576

5.5.2.2.2 Results

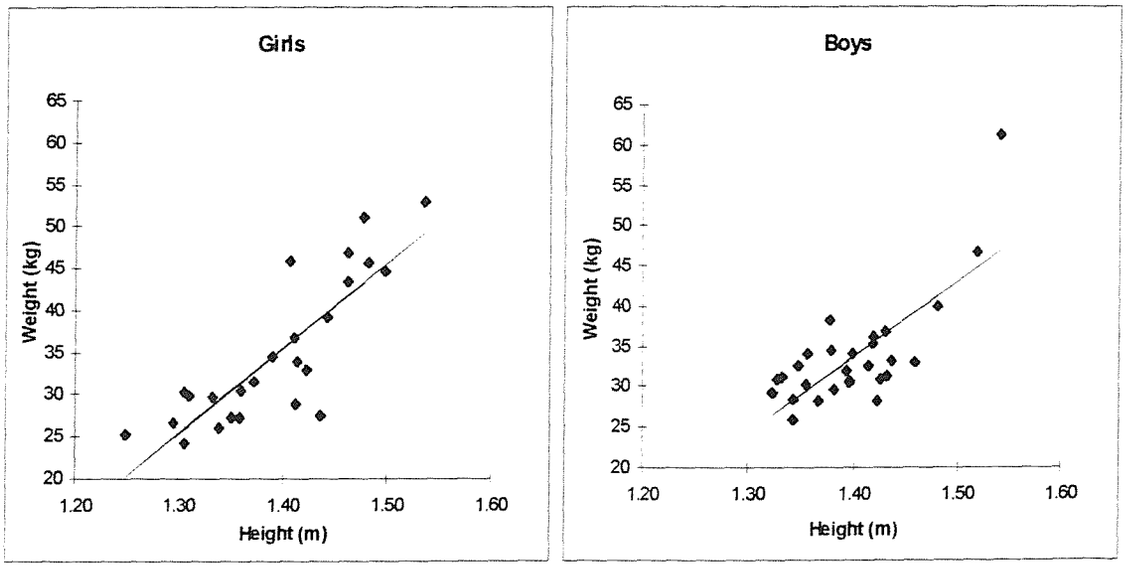
Looking at the results by sex, there were no significant differences between the mean values of girls and boys with regard to their height, weight, BMI or BMR (Table 50).

Table 50: Mean and Standard Deviation of Heights, Weights, BMI and BMR

	Girls (n=25)			Boys (n=28)		
	Mean	SD	Range	Mean	SD	Range
Height (m)	1.39	0.07	1.25-1.54	1.40	0.05	1.32-1.54
Weight (kg)	34.9	8.7	24.2-52.9	33.8	6.8	25.8-61.3
BMI (kg/m^2)	17.8	2.9	13.3-23.4	17.1	2.3	14.0-25.6
BMR (MJ/d)	4.83	0.59	4.00-6.07	5.05	0.46	4.51-6.82

One boy was above the 98th centile for height and above the 99th centile for weight for age. When this child was excluded there was a wider range of heights and weights among the girls than the boys. Figure 33 shows the height and weight distributions of girls and boys.

Figure 33: The distribution of heights and weights for girls and boys



The three groups of children (those who completed weighed records, those who did food diaries and those who did neither), were also compared with respect to their heights, weights, BMI's and estimated BMR's to see if there were any significant differences between the groups. Table 51 shows the results.

Table 51: Heights, weights, BMI and BMR by food record type

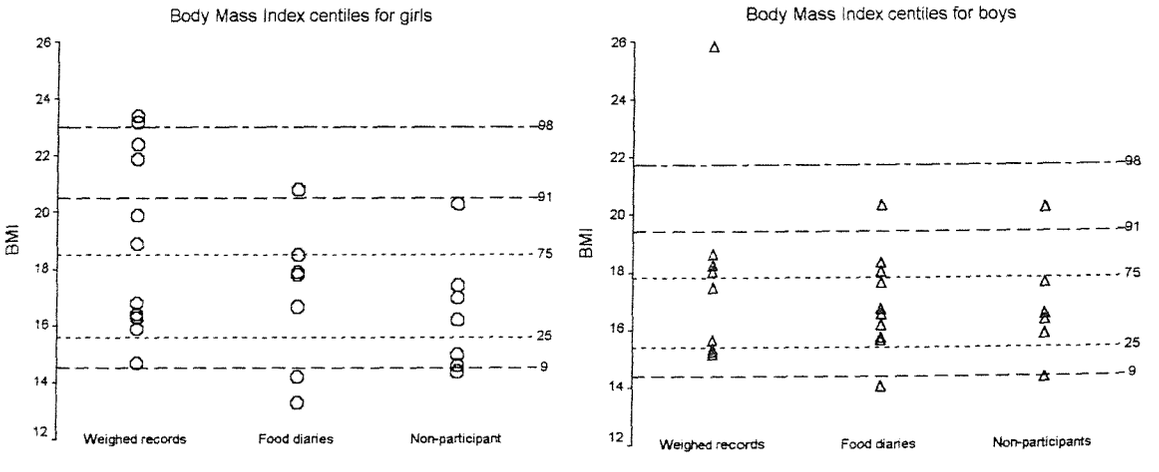
	Weighed records (n=20)		Food diaries (n=19)		Non-participants (n=14)	
	Mean	SD	Mean	SD	Mean	SD
Height (m)	1.42	0.06	1.41	0.06	1.36	0.06
Weight (kg)	37.6	9.6	33.6	7.2	30.9	5.2
BMI (kg/m^2)	18.4	3.3	17.0	2.0	16.5	1.7
BMR (MJ/d)	5.23	0.64	5.06	0.46	4.83	0.36

One member of the food diary group was not available when the heights and weights were measured. Three of the non-participants were not weighed or measured.

The mean heights, weights, BMI's and estimated BMR's were greatest in the weighed record group and lowest in the non-participant group but the differences between the groups were not statistically significant.

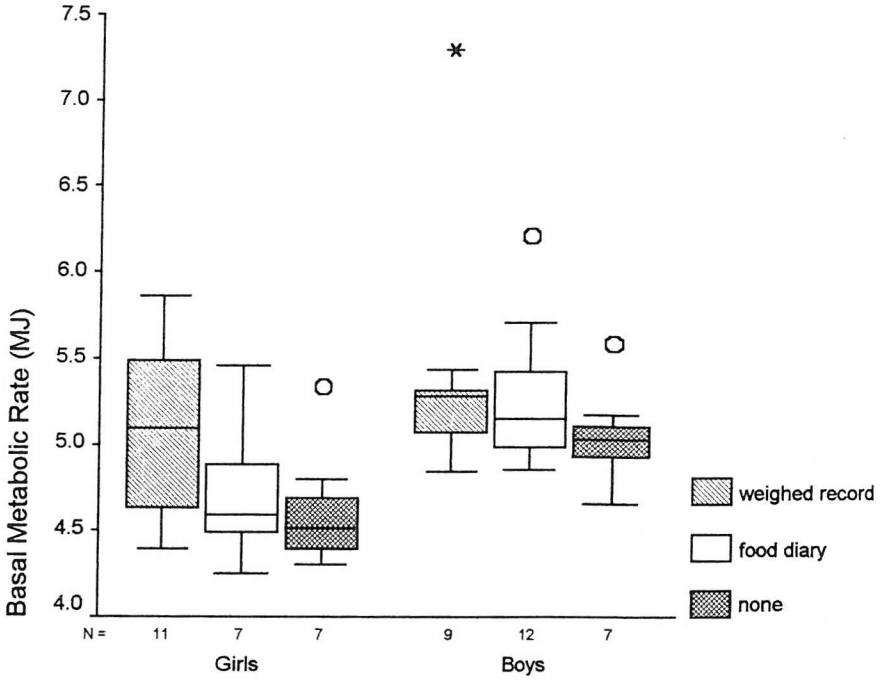
Figure 34 below shows the distribution of BMI's by sex and by record type. The three children with BMI's above the 98th centile were in the weighed record group.

Figure 34: BMI by record type and UK reference curve centiles for 10 year olds



The box plot below (Figure 35) show the median, interquartile range and the range (except outliers) basal metabolic rate (BMR) by sex and food record type.

Figure 35: Basal Metabolic Rate by sex and food record



O = Outlier (cases with values 1.5 to 3 box lengths from the lower or upper edge of the box).
* = Extreme (cases with values > 3 box lengths from the lower or upper edge of the box).

As would be expected from the scaling factor in the formulae, the predicted BMR's were lower in the girls than the boys, but again the girls in the weighed record group had the greatest interquartile range. The boys in this group had one extreme value.

5.5.2.2.3 *Discussion*

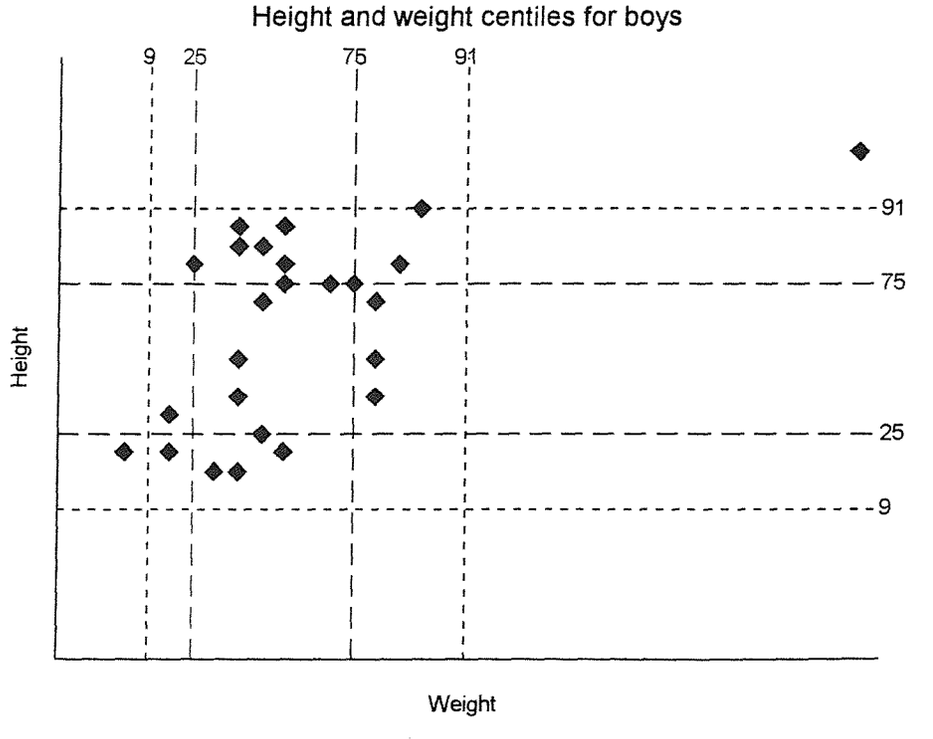
The median height and weight of the study group was similar to the UK reference values (Freeman *et al.*, 1995) with median values of 31.5kg for girls and 32.5kg for boys, and a wider range of values for girls than boys. (Table 52).

Table 52: UK reference values for weights of 10 year olds.

	Weight (kg)		Height (m)	
	Median	Interquartile range	Median	Interquartile range
Girls	32.4	28.9 – 41.2	1.38	1.34 – 1.43
Boys	31.5	28.4 – 35.2	1.38	1.34 – 1.43

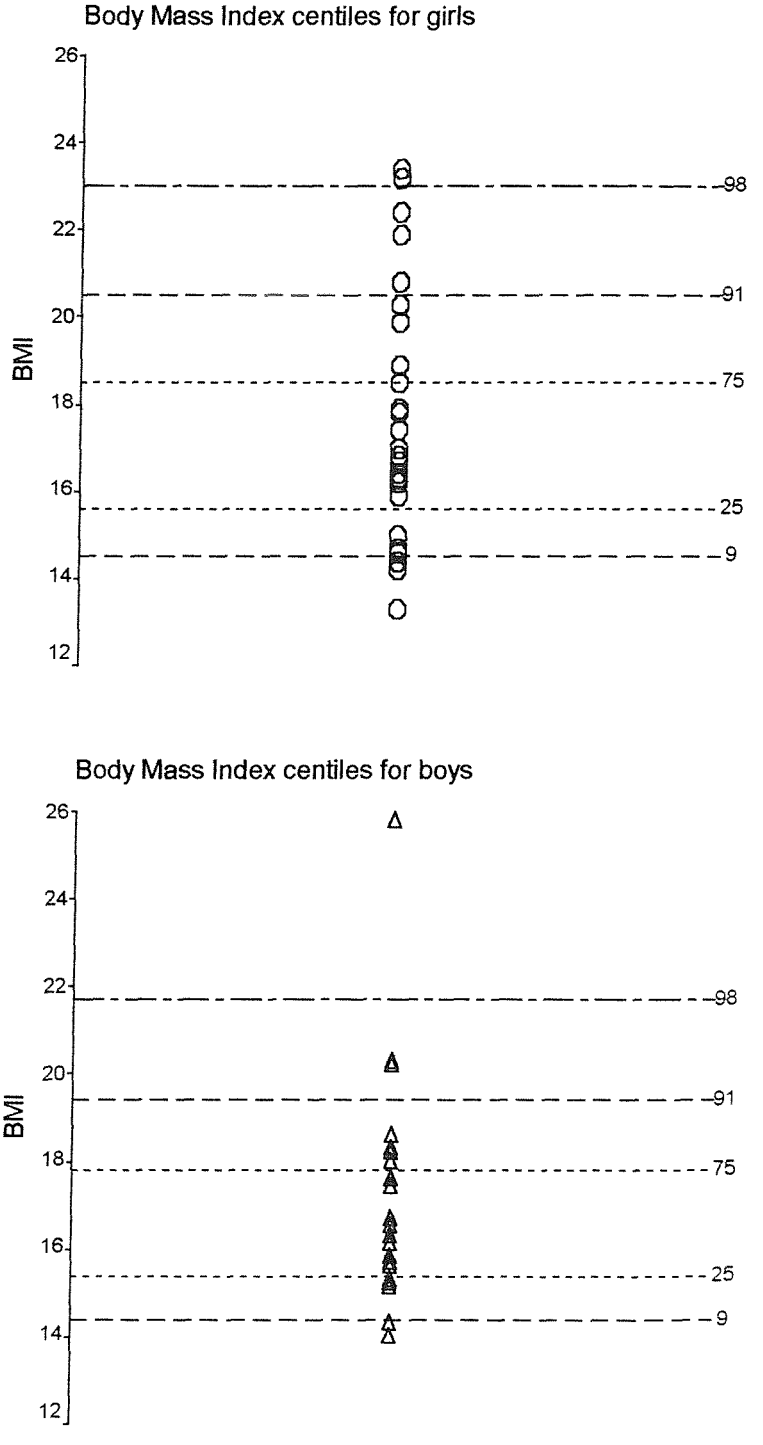
One boy and six girls were above the 91st centile for weight for age and one girl was below the 9th centile. Two girls and one boy were above the 91st centile for height and one girl was below the 9th centile. (Figure 36).

Figure 36: UK reference curve centiles for height and weight for 10 year olds



The problem with height and weight curves is their inability to measure fatness. A composite measure, Body Mass Index (BMI), provides a simple measure of fatness based on weight adjusted for height. Using the UK BMI reference curves derived by Cole et al (Cole *et al.*, 1995), two girls and one boy had BMI's above the 98th centile (Figure 37).

Figure 37: UK BMI reference curve centiles for 10 year olds



The National Diet and Nutrition Survey (Office for National Statistics (Social Survey Division), 2000) also found similar heights and weight for 10 year olds as this study (Table 53).

Table 53: Heights and weighs of 10 year olds in the National Diet and Nutrition Survey

	Weight (kg)		Height (m)	
	Mean	s.d.	Mean	s.d.
Girls n=68	36	7.2	1.40	0.08
Boys n=70	37	9.5	1.41	0.06

5.5.3 Comparison of Food Diaries against the Reference Standard

5.5.3.1 Method

The food diaries were compared to the reference standard weighed records. The anthropometric and demographic details were compared to assess if there were any significant differences which may introduce bias into the results. The records were compared by food group in terms of both numbers of foods recorded and the proportions.

5.5.3.2 Results of anthropometric and demographic analysis

A comparison was made of heights, weights and demographic details between those children who filled in weighed records and those completing food diaries. This was done in order to establish whether there were any substantial differences that may lead to a biased result. The comparison of the food diaries against the weighed records compared the proportions of foods in the five food groups.

In all, there were twenty weighed records and twenty food diaries available for analysis by food group. One child left the school during the study period. This left seventeen children who either did not return a food record or whose record was insufficient to analyse.

Comparing anthropometric or demographic details there were no significant differences between the two food record groups of children. They are, however, small samples. (Table 54 and Table 55).

Table 54: Heights, weights, BMI and BMR by food record type

	Weighed records (n=20)		Food diaries (n=19*)		t-test
	Mean	SD	Mean	SD	*p* value
Height (m)	1.42	0.06	1.41	0.06	0.25
Weight (kg)	37.6	9.6	33.6	7.2	0.10
BMI (kg/m^2)	18.4	3.3	17.0	2.0	0.11
BMR (MJ/d)	5.23	0.64	5.06	0.46	0.34

* One child was absent when measures were taken.

Table 55: Demographic details by food record

Family circumstances	Weighed Record (%) (n=20)	Food Diary (%) (n=18)	Mann-Whitney U* *p* value
Home owners	75.0	83.3	0.70
Non-manual workers	61.1	68.8	0.74
Family unit			
Two adults	90.0	83.3	0.55
1 or 2 siblings	90.0	77.8	0.94

*1-tailed test

5.5.3.3 Results of the comparison by number of portions

The average number of portions of food per day recorded by the weighed record group was compared to those completing a food diary (Table 56). It was found that the weighed record group recorded more portions for all food groups except meat, fish and alternatives.

Table 56: Average number of portion per day by food group and record type

Food Group	mean (s.d.) of portions per day		t-test
	weighed record	food diary	*p* value
Bread, cereals and potatoes	3.9 (0.7)	3.5 (0.8)	0.11
Fruit and vegetables	2.7 (1.3)	1.8 (0.9)	0.01*
Milk and milk products	2.7 (1.1)	2.2 (1.0)	0.15
Meat, fish and alternatives	1.6 (0.4)	1.7 (0.5)	0.32
Fat and sugar	3.2 (1.3)	2.3 (1.5)	0.05*

* weighed records significantly > food diaries – (2-tailed t-test)

Using a two-sample t-test a significant difference was found between the number of portions recorded by the two different methods for fruit and vegetables and fatty and sugary foods (p=0.01 and p=0.05 respectively).

5.5.3.4 Results of the comparison of proportions by food groups

The difference in the number of portions consumed by the two groups may be because the children in the weighed record group selectively ate more, or a parent served them with more of the foods that they know are considered as 'healthy' options. Alternatively, it may be that the weighed record group had more parental input and were, therefore, better at recording all the foods consumed. This seems a more likely explanation, as the weighed record group also recorded more fatty and sugary foods. In order to examine this further, the proportions by each food group were determined.

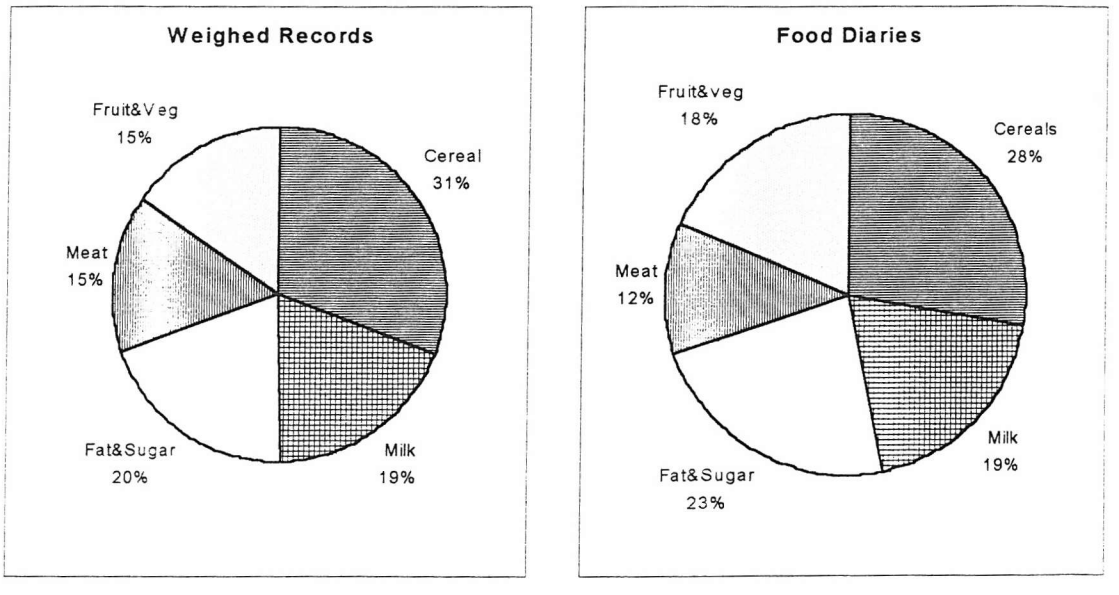
Comparison of the mean percentages between weighed records and food diaries showed no significant difference between the food groups except for meat, fish and alternatives (Table 57 and Figure 38). After excluding the meat, fish and alternatives group, there continued to be no significant difference between the proportions by food group between weighed records and food diaries.

Table 57: Comparison of mean percentages of food groups

	Weighed record group		Food diary group		t test
	mean (%)	SD (%)	mean (%)	SD (%)	*p* value
Bread, cereals and potatoes	30.8	5.8	27.8	4.8	0.08
Fruit and vegetables	15.3	5.9	18.7	7.5	0.12
Milk and milk products	18.9	7.5	18.8	6.5	0.98
Meat, fish and alternatives	15.2	4.9	11.6	4.1	0.01*
Fatty and sugary foods	19.8	10.8	23.2	9.4	0.30

* 2-tailed t-test

Figure 38: Comparison of the proportion of foods by food group by record type



5.5.3.5 Discussion

The number of children involved in the study was small and, although the anthropometric and demographic differences between the children completing food records and those not participating were not statistically significant, caution should be observed in extrapolating the findings to this group.

There were significantly more portions of food (except meat, fish and alternatives) recorded by the weighed record group than the food diary group over the four recording days. It was clear from discussions with the children that those who

completed the food diaries tended to fill in the diaries after they had eaten. The weighed record group filled in the details before they ate the food and then recorded any foods left over. This may have led to omissions in the foods recalled by the food diary group or failure of the weighed record group to record left over food.

The Berg *et al.* found that fewer foods were recorded towards the end of the week and there was an increase in the number of non-recorded days (Berg *et al.*, 1998). The authors concluded that surveys with repeated recording periods and fewer consecutive days would improve validity.

The fewer foods recorded by the food diary group may be due to greater participant fatigue among these children as the study progressed. This has been found in other studies (Berg *et al.*, 1998; Carroll *et al.*, 1997). (The weighed record group also recorded fewer items of food on day four compared to day one, although the difference was not significant). The weighed record group may have been more motivated and supported by their parents. Results from the reliability study (section 5.4) suggest that children do under-report their dietary intake (particularly fruit and vegetables) but that the differences are not statistically different from reports by their parents. The reliability study was carried out on the first day of the recording period when participant motivation is likely to be at its best.

The similarity in the number of portions recorded in the meat, fish and alternatives group by the two study groups (i.e. 1.6 versus 1.7) may be because, overall, few portions from this food group are eaten each day. Also, these foods tend to form the major part of a main meal and are therefore more likely to be recorded. There is evidence for this tendency in the 24-hour recall studies (section 5.2) where there was little difference in the number of portions of meat, fish and alternatives recalled by the children and reported by parents.

The fact that there were no significant differences between the proportions of food groups excluding meat, fish and alternatives suggests that food diaries could be a useful indicator of dietary habits in a prepubescent population. A larger scale study would be needed to determine if there were any consistent patterns in the rates of reporting by food group. It could be that children tend to under-report

foods eaten between main meals. This may have a more pronounced affect on some food groups compared to others. For example, if fruit is frequently eaten as a snack between meals then this would lead to under-reporting in the fruit and vegetables group. If it was found that there were differential rates of reporting by food group, then a series of scaling factors could be determined for each group. These correction factors could be used to produce population averages.

Summary finding

On the whole, if the proportion of food portions are examined rather than the actual number of portions, the food diaries give a similar picture to that of weighed records at a population level. An advantage of a food diary compared to a weighed record is that it is quicker and easier for the children to complete, and simpler to analyse.

5.6 Chapter summary

Three techniques were developed to record dietary information in prepubescent children; a 24-hour recall, a food type questionnaire and a food diary. A 24-hour recall may provide an estimate of average consumption at a population level but gives limited information on usual diet at an individual level. The food type questionnaire will provide information on usual patterns of selected foods. The food diary is a prospective method (and therefore does not rely on memory) and is a record of current eating habits.

24-hour recalls

Two methods of collecting 24-hour recall data from prepubescent children were examined, listing or drawing the food items.

In the first study children listed their recall data. Compared to dietary information provided by their parents, children recalled nearly 75% of their diet accurately or by substituting similar foods which would not affect the 'Balance of Good Health' proportions. Girls were better at recall than boys, recalling 80% of actual or

substitute foods. Recall between genders was not significantly different but the number of children was small. This issue needs to be investigated further to identify any possible gender bias.

Testing the two different 24-hour recall methods, drawing and listing, it was found that there was no significant difference in the ability of the children to recall their diet using either method. The advantages of the drawing method were that it provided more descriptive information of the foods and children enjoyed the exercise. However, it took more time to complete the task and this allowed greater interaction between the children and the possibility of children being influenced by foods which their neighbour drew.

There was significant correlation between what the children recalled and parental reports. For all food groups, except the meat, fish and alternatives group, the children under-reported their intake compared to parental information. Meat, fish and alternatives were reported with relative accuracy. This could be because the number of portions of meat, fish and alternatives eaten per day are relatively few, and they usually form one of the main constituents of a meal. With regard to the overall proportions by food group, there were no significant differences between what the children recalled and what their parents reported, at a group level.

In conclusion, the use of a self-completed, 24-hour recall form divided into meal and snack periods could be an easy and inexpensive method for collecting dietary information by food groups from prepubescent children, at a population level. Increased detail could be obtained by using a draw and write technique, but this has to be weighed against the possibility of increased interaction between the children.

Food diaries

Food diaries have the advantage of being relatively easy to complete and give a better representation of current eating habits than a 24-hour recall. Using a similar format to the 24-hour recall sheets, food diaries were divided into seven meal and snack periods with a page for each day. A class of prepubescent children completed a food diary for five consecutive school days.

The results from the 5-day food records highlighted several issues. Firstly, it was established that children of this age could complete the diaries with relatively little

adult involvement. Secondly, that the information could be categorised into food groups. Thirdly, prepubescent children were capable of grasping the concept of the 'Balance of Good Health' food groups when information was fed back to them. Problems were also identified, namely that the record only covered school days and that the completeness of recording fell towards the end of the study period.

In order to enhance the ability of the assessment tool to provide reliable estimates of intake, it was decided that it would be of benefit to reduce the number of recording days, to increase the level of support by providing daily contact, and to include a weekend day. Further work carried out in the development of food diaries reduced the number of recording days to four, with one of these days being a weekend day. (The preliminary studies had included five consecutive school days).

It was found that the proportions of foods by food group were similar for the 5-day food diaries completed in the preliminary work and the 4-day diaries. This would suggest that, in this particular socio-economic population, the food diary method for collecting data were consistent.

The question of the reliability of children's records was examined by comparing a single day's record with parental information. On average, the children recorded 95% of the foods and drinks parents reported. There was a high degree of correlation between children's records and parental reports. Fruit and vegetables were most commonly under-reported (11% omission rate). However, there were no significant differences in the proportions of foods by food group. The main difference between the parental reports and the information recorded by the children was in the amount of detail provided. The children were less likely to write a detailed description of the food or the cooking method. The use of a parental food type questionnaire would enhance the detail provided by the children. Alternatively, the food diary could be used as the basis of a draw and write exercise, as it was found that children tend to provide more detail in their drawings. The advantages of using drawings are that they do not require parental information and that they help to enhance information where children lack the necessary literacy skills. The disadvantage of an additional draw and write session is the extra time and expense incurred in carrying out the exercise.

Overall, prepubescent children were capable of providing dietary information using food diaries. Therefore, the diaries would be a feasible way to collect dietary information but may need to be supplemented by drawings and/or parental information.

Comparison of food diaries with the reference standard

Weighed records were used as the reference standard to compare with the food diaries. A second group of children from the same study population weighed and recorded all the foods they ate over the same 4-day period as the children completing food diaries. There were no significant differences in anthropometric or demographic details of the two groups but the number of children in the study was small.

The weighed record group recorded significantly more portions of food for all the food groups except meat, fish and alternatives. There appears to be a consistent pattern of recording of foods from the meat, fish and alternatives group among prepubescent children. Compared to parental reports, children accurately recorded meat, fish and alternatives for both the 24-hour recalls and the food diaries. This may be because few foods from this group are consumed each day and they usually form one of the main components of a meal.

When considering the proportions of foods by food group, the food diaries produced a similar picture to that of the weighed records. If this were found to be true in a larger, more representative sample of the general population of prepubescent children in the UK, then this method of dietary assessment would be a relatively inexpensive method for population monitoring.

6 Summary, Conclusions and Future Research

Aims

1. Develop appropriate methods consistent with the Government's 'Balance of Good Health' food-based dietary guidelines to:
   i) assess nutrition knowledge in prepubescent children
   ii) enhance the guidelines for prepubescent children.
2. Develop appropriate dietary assessment tools for use with prepubescent children in the classroom setting in order to:
   i) assess and monitor food patterns at the population level.
3. In order to analyse nutritional data from assessment tools, develop a food group database based on the Government's 'Balance of Good Health' dietary guidelines which is capable of:
   i) measuring food consumption patterns
   ii) detecting change in dietary behaviour and nutrition knowledge.

6.1 Synopsis

The overall aim of this research was to develop appropriate food-based nutrition assessment and education tools for use in a prepubescent population, in line with current national dietary guidelines. The project covered two main areas, the development of nutrition education tools to assess and enhance nutritional knowledge and the development of dietary assessment tools. It is intended that the methods developed in this project provide evidence-based information for the evaluation of nutrition intervention programmes.

The project firstly developed a method of analysing food in terms of food groups, with output in a format similar to the current food-based national dietary guidelines. This database was used to analyse the data collected using the nutrition knowledge and dietary assessment tools developed within the project.

The range of nutrition knowledge assessment methods developed in this project has proved useful in the teaching field to highlight target areas to improve prepubescent children knowledge. However, the tool requires further evaluation in a larger group of children to establish reliability at the individual level. The educational tool devised to aid prepubescent children understanding of the principles of the 'Balance of Good Health' guidelines was found to be a practical way in which to help children to make healthy food choices.

The project has demonstrated the possibility of using either a 24-hour recall or food diary method to collect qualitative dietary information from prepubescent children, at the group level. Information from both these methods can be enhanced with information from a parental food type questionnaire. Further trials are required in a larger, more diverse prepubescent population in order to establish the generalisability of the assessment methods. Future work will develop methods for the assessment of diet at the level of the individual.

6.2 Background

To date, there have been few studies into the nutrition knowledge and dietary behaviour of prepubescent children. Those that have looked at diet have often been small studies involving parents, trained dieticians and interviewers, and a great deal of time and expense. The development of classroom-based, self-completed nutrition knowledge and behaviour assessment tools is important if we wish to have an inexpensive method for collecting data for large-scale epidemiological studies. The primary question is: Can prepubescent children provide information which is sufficiently accurate to measure nutrition knowledge and dietary behaviour? Following on from that, what are the most appropriate methods of obtaining the data? We also need to ascertain whether prepubescent children understand current nutrition guidelines or, if there are problems, how we can enhance their understanding. The current guidelines are represented in a pictorial format, i.e. the 'Balance of Good Health' plate. The plate is divided into five food groups and shows examples of the types of foods in each food group.

The 'Balance of Good Health' guidelines are intended to be flexible to allow for personal needs and tastes while providing a nutritionally adequate diet. The guidelines take a holistic approach to the diet, with a positive emphasis on what to

eat rather than emphasising what not to eat, looking at the diet in terms of foods rather than nutrients. This is particularly useful for children who can understand healthy messages in terms of foods but may find it difficult to understand the concept of nutrients.

Initial research looked at the developmental stage of the children, to gain an understanding of their cognitive abilities, and to examine dietary assessment methods which may be amenable to adapting for use in a prepubescent population. It was confirmed that prepubescent children are still developing their cognitive and communication skills. This was taken into account when developing the tools for use in this age group. As children generally have a shorter attention span than adults, any methods employed had to be able to keep the children's attention and enthusiasm long enough to complete the task. Another important criterion was that any assessment tool developed for use in school needed to fit in with other curricular activities.

A review of available dietary assessment methodologies suggested that, because of limited cognitive and communication skills in prepubescent children, 24-hour recalls or a food diary may be suitable in this population to adapt for use in the classroom setting.

6.3 Preliminary Work

The objective of the preliminary work was to look at usual food patterns and eating habits of a sample of prepubescent children who were representative of the intended study population; to identify appropriate means by which children of this age can communicate nutrition information; and to examine possible methods for prepubescent children to estimate portion sizes.

The preliminary work, involving discussion groups with children, parents, teachers and school catering staff, and an observational study, helped establish a list of foods commonly eaten in this particular socio-cultural group of children. Feedback from the children indicated that the use of a meal-based structure was the most useful way for them to remember their diet. The children also expressed a desire to draw pictures of their food. This information was used to inform the tool development stage.

The issue of the children's ability to perceive and conceptualise portion sizes was also examined during the preliminary stage. Three methods were investigated; drawing, selection from a series of small photographs and using a series of life-sized computer images. In a small sample of children, it was found that there was some proportionality between two food items they drew. However, it was relatively difficult to analyse and interpret the data, which may make this an unrealistic method for large-scale studies. There were few differences between children's perception and conceptualisation of portion sizes using small photographs. In general, portion sizes were overestimated, but there were wide variations between the children. Children still overestimated portion sizes using life-sized computer images, but there was less variation between the pupils. Life-sized computer-based images warrant further investigation for possible use with individual children. However, with such wide variation in portion size estimates, it may be difficult to obtain sufficiently accurate portion size information from children of this age. The time and expense involved in obtaining portion size information may not be worthwhile for large-scale, epidemiological studies. For these reasons, the nutritional assessment tools developed within this project have not required portion size data from children.

6.4 The Food Group Database

The objective of the development of a food-based analytical database was to examine the feasibility of describing nutrition information in terms of food groups. Analysing nutrition information by food groups, rather than the traditional nutrient basis, is a relatively new approach. The underlying principle for the food group database was the UK Government's food-based dietary guidelines. Therefore, the next stage of the project was to develop the database using the 'Balance of Good Health' food-based guidelines (Department of Health, 1994c) as the foundation. It was intended that the database should be capable of measuring food patterns in terms of food group, and that it should be able to detect change in nutrition knowledge or behaviour. The development of the food group database took place in parallel with the assessment tools.

Based on the premise that prepubescent children have proportionally similar food intakes as adults, the initial standardised food group database allocated foods by

standard portion weights to food groups. These followed the same assumptions used in developing the 'Balance of Good Health' dietary guidelines. Composite dishes were proportionally allocated to two or more food groups.

Using data from a set of weighed records, the output by food group using standardised food weights was compared to that using actual weights. It was found that there were no significant difference between any of the food groups except the meat, fish and alternatives group (standard weight 135g vs. actual mean weight 108g, $p<0.001$).

Standard weight classified eighty percent or more children into above or below average consumption for all the food groups except bread, cereals and potatoes. On further investigation into the bread, cereals and potatoes group it was found that, on average, the children consumed more bread and breakfast cereals than standard portion weights but less pasta, rice and potatoes.

The results from this pilot work indicates that the use of standardised weights based on adult data is not adequate to describe the average meat, fish and alternatives consumption of prepubescent children and fails to categorise the majority or children with respect to bread, cereals and potatoes. Before this database can be utilised further research is required to determine appropriate standard food weights for this age group.

Another issue identified from the study was that food specific standardised weights require children to be accurate about the actual foods they eat and not simply report generic types. Preliminary work suggested that complete accuracy could be problematic. Finally, the use of the standardised food group database within the classroom may be impractical if there is no access to computing facilities. Therefore a simplified version of the food group database was constructed.

The simple food group database allocated a portion of food to the appropriate food group regardless of food weight. Composite foods were allocated to the food group containing its main constituent part, unless there was an obvious division of components (such as spaghetti meat bolognese was allocated as one portion of pasta and one of meat, fish and alternatives). Some foods such as milk in tea, fat spreads and bread toppings were allocated as a fraction of a portion. Comparing

the mean percentage by food group of simple portions with using actual weights of the set of weighed records, there were statistical differences between bread, cereals and potatoes, and the fatty and sugary foods group. The simple food group database underestimated the proportion of bread, cereals and potatoes and overestimated the proportion of fatty and sugary foods compared to actual weights. However, as an educational tool it was useful in highlighting the under consumption of fruit and vegetables and bread, cereals and potatoes while emphasising the over consumption of fatty and sugary foods. Therefore, as this database provides a simple, easy method to analyse foods in terms of food groups, it was used for the analysis and presentation of data derived from the assessment tools developed within this project.

While the simple food group database is capable of measuring change between food groups, one disadvantage is its inability to differentiate between foods within the same food group. For example, breakfast cereals vary greatly in their proportion of energy from fat and sugar but they are treated equally for the purposes of the database. This means that if children change their consumption of high fat and sugar cereals to lower fat and sugar types they will see no corresponding change in the output represented by the 'Balance of Good Health' pie chart. Further research is underway to determine if it is possible to modify the database in order to incorporate changes within food groups.

Another issue worth highlighting is that the 'Balance of Good Health' guidelines advise choosing a variety of foods from each of the four main food groups in order to ensure a balance of micronutrients as well as macronutrient. The use of the 'Balance of Good Health' guidelines as a basis on which to build the food group database, assumed that children would eat a variety of foods from within each of the food groups. However, using food groups as the basis of analysis does not identify the variation within food groups, and therefore it is not possible to measure the variety of foods within a particular food group.

In conclusion, at the population level, it is possible to describe basic food patterns in the form of food groups compatible with current national dietary recommendations.

6.5 Nutrition Knowledge and Education

One of the primary aims of this project was to develop nutrition knowledge assessment and nutrition education tools for use with prepubescent children in the classroom. The objective was to identify and develop appropriate methods for prepubescent children to communicate their nutrition knowledge; to assess nutrition knowledge and measure change following nutrition education; and to enhance the 'Balance of Good Health' guidelines to improve prepubescent children understanding of the nutrition messages and to increase their ability to put those messages into action.

An integral step in changing dietary behaviour is the acquisition of knowledge. Nutrition education is now a core curriculum requirement for children throughout their school career. The use of a pre- and post-nutrition education assessment tool will indicate how well the children have assimilated the knowledge.

The food-based 'Balance of Good Health' guidelines are an appropriate method to educate prepubescent children on a healthy, balanced diet, because children relate to foods but may not have the knowledge to understand nutrient-based information. The use of a food group database to analyse nutrition knowledge enabled the information to be fed back to the children in the same format as the nutrition education lessons.

6.5.1 Draw and Write

Prepubescent children's communication skills are not fully developed; therefore, it was felt appropriate to explore the use of a draw and write method to determine children's nutritional knowledge. The method was found to be acceptable to both the children and the staff. The results of a study looking at a healthy, balanced meal indicated that the method could be used as a measure of children's knowledge.

The method was advantageous from the point of view of providing more detail than if the children had simply written a list. The children were enthusiastic about the exercise and it held their attention throughout. The children were able to understand the feedback of the results in the form of a pie chart, and staff found the exercise useful in highlighting areas of misunderstanding and lack of

knowledge in the children. The staff used the information to enhance their nutrition education programme. The amount of time taken for the exercise had the disadvantage of allowing a certain amount of interaction between the children; this may have influenced some of the drawings.

The draw and write method was subsequently used to test the change in nutritional knowledge following nutrition education. A class of 9 to 10-year-olds was asked to draw a healthy, balanced meal before and after a fortnight of nutrition education. The data analysed using the simple food group database, showed a change in emphasis. In the pre-nutrition education drawings, 67% of the items drawn were from the fruit and vegetable group. Post-education there was still an emphasis on fruit and vegetables, accounting for 50% of food items. However, it was important to note the number of items drawn, as well as the proportions by food group, as the change in proportions was almost entirely due to a reduction in the number of fruit and vegetables drawn, rather than an increase in the number of portions of food from the other four food groups.

It is difficult to produce a balanced diet, in line with the 'Balance of Good Health' guidelines, for a single meal. Therefore, the research was taken one stage further and a group of prepubescent children was asked to draw meals which would constitute a healthy, balanced intake for a whole day. The children were given a sheet of paper divided into the same meal and snack periods that had been used previously, although it was made clear to the children that they did not necessarily have to draw something in every box. The results from the exercise showed that the children's knowledge of a healthy, balanced day was relatively good, although the use of the simple food group database may have underestimated the bread, cereal and potatoes group and overemphasised the fatty and sugary foods group. However, as the balance of foods can be calculated manually using the simple database, it would be an advantage for schools without access to computers to use this method. Therefore, future research will look at the possibility of producing simple weightings for the output from the food group database to reflect better the true balance of the food groups.

In conclusion, the draw and write method was a successful means of obtaining nutrition knowledge from prepubescent children. The children were both enthusiastic and attentive throughout the exercise. Producing feedback in the form

of the 'Balance of Good Health' pie chart, helped the pupils to understand the balance of the foods they had drawn. The use of the average number of portions of food drawn, in addition to the overall proportions, provided valuable information to staff. This information highlighted the areas that the teachers needed to target in order to improve the children's nutritional knowledge.

6.5.2 Food type questionnaire

The ability of children to recognise the low fat and low sugar foods that they eat, and the extent to which they are aware of cooking methods in the home, was investigated through a food type questionnaire. Information from the preliminary studies was used to develop a questionnaire that concentrated on selected food items commonly eaten by children of this age. There was a 68% agreement between information provided by parents and the answers reported by the children. As with the 24-hour recalls, the girls scored higher than the boys, but the difference was not significant. Once again, it would be prudent to investigate this further in a larger sample of children. In all, 88% of parents returned the food type questionnaire. It may prove more useful to use the information provided by parents to enhance other information reported by children, than to rely on children's knowledge alone. However, this may not be a representative sample of parents, and response rates from parents in different cultural or social circumstances may be considerably lower. In this case, the use of the children's questionnaire may improve information from other dietary assessment methods. A further adaptation of the food type questionnaire, to be investigated in the future, is to ask the children to draw, for example, a picture of the type of spread they put on their bread. This would allow children with lower literacy skills to answer the questionnaire with greater accuracy. Although there may be a degree of interaction between the children, comparison with a parental report will indicate the accuracy of this method.

6.5.3 Allocation of foods to food groups

If prepubescent children are to be able to use the 'Balance of Good Health' guidelines to look at their own diet, they must be able to recognise which foods belong to which food groups. A simple experiment was set up in order to assess

the ability of prepubescent children to identify food groups. From information gathered during the preliminary work, a list was compiled of foods commonly eaten by children of this age. A group of 9 to 11-year-old children were each given the name of a food and asked to allocate the food to the food group they thought it belonged to. Almost 90 % of children identified the correct food group. The older children identified more foods correctly than the younger children, but the difference was not significant.

The food allocation method was developed further in order to test the knowledge of individual children. Two combination foods were also included in the list. On average, the children allocated just over 71% of the foods correctly. Combination foods, and those foods which were normally used in combination with other foods, were most often misallocated. For example, macaroni is often cooked with a cheese sauce and was frequently allocated to the milk and milk products group. This indicates that the allocation of foods to food groups may need to be explained in more detail to prepubescent children. When the exercise was repeated, 74.8% (s.d. 10.2) of the answers were the same as in the first allocation exercise. The average score on the second exercise was significantly better than the first time (76.6%, $p<0.0001$). This was the result of a learning effect. However, there was a significant correlation between the two scores ($r=0.8$, $p<0.0001$). When ranking the children into thirds, 48% remained in the same third, 9% were in the opposite third.

To conclude, the allocation exercise has several uses within the teaching field. It can be used to explain the concept of food groups to prepubescent children. As a simple knowledge assessment tool, it can be used to assess children's knowledge before and after nutrition education. It can also be used to identify and target children who may not understand the nutrition messages.

6.5.4 Substitute foods

If children are to be able to make choices about the types of foods they eat, they need to be able to understand something about the nutrient values of foods. One of the aims of current dietary guidelines is to move away from high fat and sugar foods and to increase the consumption of cereal products, fruit and vegetables. However, it is unrealistic to expect dramatic dietary changes in the short-term.

Reduction in fat and sugar consumption, by moving to lower fat and sugar varieties of food, is a step in the right direction. If prepubescent children are to be encouraged to eat lower fat and sugar varieties of foods, then they need to be able to identify them.

First, an experiment was set up to look at prepubescent children's ability to identify nutrition information from manufacturer's labels. Breakfast cereals were chosen, as it was evident from preliminary work and a review of the literature, that they are consumed frequently by this age group. From the results of the exercise, it was found that children understood the concept of low energy foods but they had insufficient arithmetic skills to allow them to calculate the fat and sugar content of a series of breakfast cereals. Therefore, a simple tool was developed for children to use to identify the fat and sugar content of foods. The tool consisted of a 'tower' of six boxes, ranging from low fat and sugar types of cereal at the top to high fat and sugar cereals at the bottom, and colour-coded from light to dark. It was found that the children understood the 'tower' and were able to understand the concept of substituting lower fat and sugar cereals in place of ones with a higher fat and sugar value. 'Towers' were also constructed for cakes, biscuits and snack foods as these are likely to be the types of foods over which prepubescent children can make a choice. This tool allows children to understand and make choices about the different varieties of foods within the same food type.

In conclusion, prepubescent children have insufficient cognitive and developmental skills to be able to interpret nutrition information from nutrition labels. Therefore, they are unable to use them to assess the nutrient content of foods. The 'towers' method provides information on substitute foods within the same food category, in a format that is easily understood by prepubescent children. This enhancement of the 'Balance of Good Health' guidelines is a practical way to enable prepubescent children to make realistic, healthy food choices.

The 'Balance of Good Health' guidelines are a good starting point for nutrition education of prepubescent children. However, children of this age need more explanation about the types of foods within each food group, as they have difficulty dealing with abstract concepts. Research by Lytle *et al.* found that nutrition messages needed to be "developmentally appropriate and give specific

behavioural messages in order to positively inform the eating choices of children" (Lytle *et al.*, 1997). Children also need to understand that altering the balance of foods within food groups, away from high fat and sugar foods towards those with lower fat and sugar, will have a favourable impact on their diet. A simple tool such as the 'towers', is an effective means of communicating that information.

6.6 Dietary assessment tools

The final part of this thesis involved the development of dietary assessment tools. It was intended that the tools would be capable of assessing and monitoring children at the population level. The objective of this part of the project was to identify and develop appropriate methods for assessing the dietary behaviour of prepubescent children, and assess the repeatability of the tools.

Since the project was to use the 'Balance of Good Health' guidelines as the foundation of the assessment work, the intention was that the results and feedback would take the same format. The first stage was to ensure that prepubescent children had sufficient cognitive skills to understand the food group 'Balance of Good Health' representation. Initial work found that prepubescent children understood the basic concept of the 'Balance of Good Health' guidelines presented in the form of a pie chart.

Preliminary work suggested that, in addition to the two dietary assessment methods established as feasible to adapt for use in a prepubescent population (a 24-hour recall and a food diary), a method to assess habitual fat and sugar intake was also required. Implications were that prepubescent children might not be aware of lower energy foods or cooking methods used in the home. The 'Balance of Good Health' guidelines recommend using lower fat and lower sugar versions of food, therefore it was important to establish whether prepubescent children could report any lower fat and sugar foods they ate and the type of cooking methods used in the home. This indicated the need to develop a food type questionnaire.

6.6.1 24 hour recalls

Two methods for collecting 24-hour recalls from prepubescent children were examined, a list and a drawing. It was evident from information gathered during the preliminary studies that dividing a list into meal and snack periods would be helpful for children as a method for collecting dietary information. Comparing a list completed by the children to that of their parents, the children recalled almost 75% of the foods reported by their parents. This is similar to other studies using more intensive methods (Lytle *et al.*, 1993; Van Horn *et al.*, 1990). Girls recall rates were better than those of boys. Although the difference was not significant, the sample size was small. This issue requires further investigation to establish if there is a bias of reporting between the genders.

Comparing children's listed 24-hour recalls with their drawings, although at the individual level there was some variation between the listed and drawn foods, there were no significant differences in the rates of recall between the two methods. There was significant correlation between the children's recalls and parental reports. The children under-reported foods from all of the food groups except meat, fish and alternatives. It is possible that, because meat, fish and alternatives constitute the main element of a meal, and the number of portions per day are relatively few, children record them with greater accuracy. Comparing the proportions in each food group, there were no significant differences between the children's recall and parental reports, at the class level, for any of the food groups.

In conclusion, the proportions derived from prepubescent children's 24-hour recalls were similar, at a population level, to those reported by their parents. Therefore, this could be a quick and relatively inexpensive method for gathering food group information from prepubescent children. Looking at the two different recall methods, the advantages of the draw and write method were that it provided an increased level of detail and the children enjoyed the exercise. However, the list method is quicker and there is less time for the children to interact with each other. Interaction between the children may influence their reporting. For the small increase in detail, it may be more advantageous to use the list method with help from the teachers to decipher some of the more interesting spellings of food items.

6.6.2 Food diaries

The use of food diaries in a prepubescent population is not well established. This project looked at the feasibility of collecting dietary data from 9 to 10-year-old children. Having established through the preliminary work, that the use of a record divided into snack and meal times was helpful to children in reporting food intakes, a food diary was designed which divided the day into seven meal and snack periods. The diary for each day was printed on a single page. The preliminary study looked at five consecutive school days. The children were given a brief training session on how to complete the diaries. The teacher reviewed the diaries each day throughout the study period.

The results from the 5-day study clarified several points. Firstly, the children appeared to be able to complete food diaries with relatively little adult involvement. Secondly, the dietary information could be categorised into the five 'Balance of Good Health' food groups. Thirdly, when the information was fed back to the class, the children understood the concept of the 'Balance of Good Health' guidelines illustrated in the form of a pie chart. The results also highlighted a couple of problem areas. Firstly, the record only covered weekdays, and it is known that eating habits are different on weekdays to those at the weekend. Secondly, the number of food items recorded each day fell towards the end of the 5-day period.

The food diary method was repeated in another sample of prepubescent children. This time the diary covered four days, including one weekend day, and the researcher reviewed the diaries daily. Comparing the two sets of data, it was found that there were no significant differences between the number of portions per day. However, the sample sizes were small. Interestingly, the inclusion of a weekend day did not affect the average number by food group. This may be because, although food habits are different weekends to weekdays, it is the specific types of food that differs, and not necessarily the balance between the food groups. The presence of the researcher each day did not appear to improve (or impede) reporting. This would suggest that this data collection method could be conducted within schools with little or no intervention from a nutrition specialist.

In the second sample of prepubescent children, there was once again a fall in the number of items recorded on the last day compared to the first, although the difference was not significant. Participant fatigue among children could be a problem, particularly if there is a bias towards under-reporting in a particular food group. For example, if the children forget to write down the snacks they have, and these snacks contribute a significant number of portions in the fatty and sugary foods group, then under-reporting would distort the balance between the food groups. Further studies in a larger sample are required to establish whether increased under-reporting towards the end of the recording period biases the results.

In order to establish the reliability of information provided by prepubescent children's food diaries, data from the first day of a food record was compared to parental information. It was found that, on average, the children recorded 95% of the items their parents reported. There was good correlation between the food groups recorded by the children and those reported by parents. Compared to parents the children reported milk and milk products most accurately. Whereas fruit and vegetables were most frequently under-reported by the children (11% omitted) although none of the differences were not significant at the 95% level of confidence.

An important difference between the information recorded by the children and that reported by the parents, was the increased amount of detail provided by the parents. The use of information from a parental food type questionnaire would enhance the detail provided by the children. Using a draw and write method may enhance the detail without parental involvement, but it would be more time-consuming and the children would have a greater opportunity of being influenced by others in the class.

It should be noted that, for each of the tools developed, the children's records were compared to those of their parent's. As it was not possible within this project to verify the accuracy of the parent's records, we cannot be certain that the differences found are true differences. However, this project has found good correlations between children's and parent's records by food group which suggests that although children tend to under-report their intake it is general under-reporting and not specific to one food group.

One further point to consider is that the parents, knowing that their child's diet was being recorded, may not have given the child their usual diet. This is not a problem within the auspices of this study as the purpose was to evaluate children's ability to provide information on their actual food intake. However, it becomes an issue when we wish to look at usual food patterns in this age group. Further work is required to establish the validity of information provided with respect to usual dietary patterns.

Weighed records were used as a reference standard with which to compare the food diaries. The children completing the weighed records were from the same two classes as the food diary sample. There were no significant anthropometric or demographic differences between the two groups of children that may have introduced a reporting bias, but again numbers were small. In comparing the two sets of data, analysed using the simple food group database, it was found that the weighed record group recorded more food items in all the food groups except meat, fish and alternatives. The differences were significant for fruit and vegetables and fatty and sugary foods. It is not clear whether the fewer recorded food items by the food diary group was a true difference or under-reporting. However, it is likely that the children completing the weighed records were more accurate as they had parental support in completing their record. It could also be the case that, being aware of healthy eating messages, the parents of the children completing weighed records altered the children's usual eating pattern by increasing the number of portions of fruit and vegetables and bread, cereal and potatoes. Results from the reliability study suggest that children completing food diaries do under-report their intake, but that the differences are not as marked as the differences between the weighed records and the food diaries. Further studies with a larger population would help to establish the degree of under-reporting by food group.

In conclusion, when analysing data by food group, food diaries are an acceptable method of collecting data from prepubescent children, at the population level. However, there is a need to be aware of the possible reduced attention to detail towards the end of the recording period, although under-reporting did not appear to be biased towards a particular food group.

6.6.3 Comparison of dietary assessment methods

Comparing the dietary assessment methods investigated in this project, when compared to their parents children under-reported their intake of all foods, except meat, fish and alternatives, with both the 24-hour recalls and the food diaries. However, when looking at the proportions of foods by food group, there were no significant differences between the children's reports and their parents. Children reported fewer foods compared to those reported by the parents when completing a 24-hour recall (75% correctly recalled), than when they completed a one-day food diary (95% correctly reported).

Prepubescent children have a limited attention span and attention to detail may wane with time when completing a 4-day food diary. Thompson *et al.* proposed that by reducing the number of recording days there will be increased precision with less subject fatigue (Thompson *et al.*, 1994). Indeed, the results of the study looking at the reliability of food diaries of prepubescent children, showed that there was a high degree of accuracy in reporting by the children, compared to the parental report, on the first day of a food diary. Therefore, at the population level, it may be more pragmatic to collect data from a single day's food log. It has been suggested that if the cost of doing a repeat measure is the same as the cost of recruiting a subject in the first place, then it would be more efficient to obtain data from a larger number of people than from many repeated measures within a smaller sample (Stram *et al.*, 1995). This is particularly important when dealing with children where their concentration span is limited.

If we wish to examine the eating habits of individual children, a series of one-day logs may be more appropriate in this age group than a 4-day diary. However, these should be conducted relatively closely together as it has been suggested that children's food habits can change rapidly (Thompson *et al.*, 1994). One of the advantages of a food diary is that children do not have to rely on their memories, therefore foods are recorded more accurately.

The advantage of a 24-hour recall is that all the children present on the day will, in theory, complete the exercise, whereas children may lose or forget a food diary (the rate was just over 11% in the reliability study). Also, it is possible that 24-hour recalls give a more realistic picture of usual eating habits, since parents (or

the children themselves) may alter their diet in order to make the diet appear 'healthier' when completing a food diary.

Both dietary assessment methods have merits and disadvantages. Which one to use may depend on the circumstances within each study population. Further research is required to establish whether the two methods give similar results as far as the 'Balance of Good Health' proportions are concerned. The 24-hour recall and the one-day food diary were collected for two different days of the week and therefore comparison is not feasible for this data.

There may be a difficulty using unquantified dietary information from prepubescent children for assessing individual dietary patterns. Although the apportionment of foods to the different food groups was relatively simple and followed the 'Balance of Good Health' recommendations, it may be unreliable to use this as the basis for providing individual dietary advice. Studies have found that a greater intrapersonal variation than interpersonal variation in the amount that people eat (Beaton *et al.*, 1979; Hunter *et al.*, 1988). A 4-day food diary may be insufficient in a prepubescent population to establish usual eating habits. A series of one-day diaries may be more suitable. In this study, there were wide individual variations in portion sizes reported by the children completing weighed records. However, as no account has been taken of portion sizes when allocating foods to food groups, the proportions by food group may be distorted. For example, a child may consistently have very small portions of vegetables but large servings of chips. This would not be detected by the food group database. Therefore, providing individual dietary advice based on these assumptions may be misleading. Further research is required to find appropriate methods of determining some form of portion size information from prepubescent children before the methods developed within this project can be used for the identification of individual dietary behaviours.

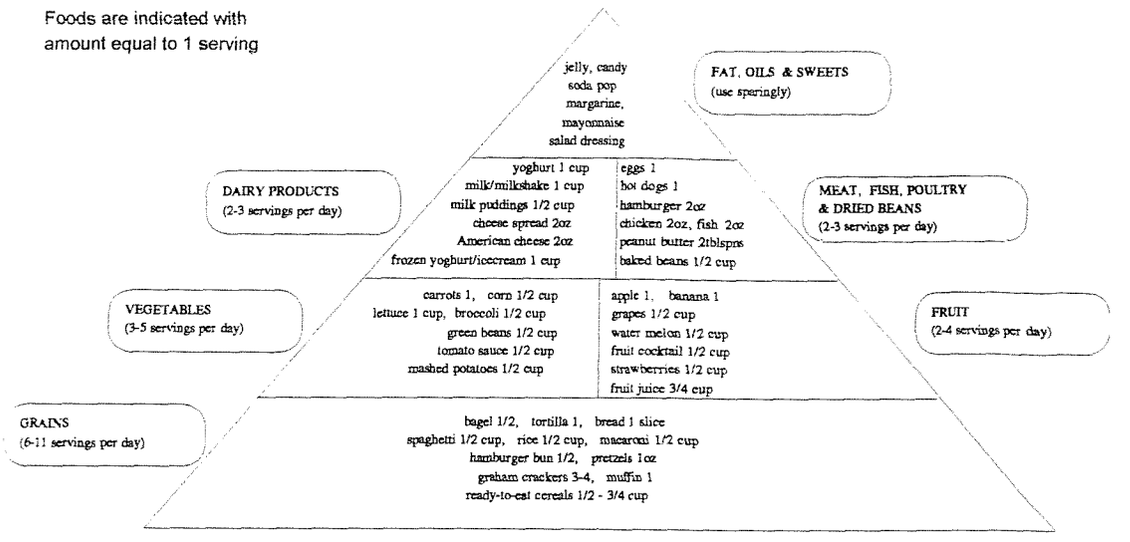
6.7 Further research

The draw and write method of nutrition knowledge assessment is useful at the class level. However, further development is required to identify individual children's knowledge and behaviour patterns. The 'towers' method of enhancing knowledge of the national food guidelines needs to be extended to other groups of foods.

The two dietary assessment methods developed within this project need to be evaluated in a larger population of children, from different socio-economic and cultural backgrounds, and the repeatability established. Further development is required to establish valid and reliable dietary information at the individual level. This may require more quantitative dietary information. Therefore, further investigations are required to evaluate the use of life-sized computerised food images as a method for defining portion sizes.

From the point of view of providing information that prepubescent children can understand, it may be useful to provide quantitative that the children can relate to. The 'Balance of Good Health' guidelines themselves, have avoided specifying portion sizes, making it applicable to all energy requirements. This framework may be adequate for adults, but prepubescent children may need guidelines that are more prescriptive. In 1996, the American Dietetic Association issued guidelines for children based on the US Department of Agriculture Food Guide Pyramid (US Department of Agriculture, 1993). Although the food groups are slightly different (e.g. potatoes are included in the vegetable group) they follow a similar theme to the 'Balance of Good Health' guidelines. The US guidelines however, are quantitative and give examples of what is meant by a 'serving' or portion (Figure 39).

Figure 39: US Dietary Guidelines for Children



Source: The American Dietetic Association. 1996.
Based on USDA Food Guide Pyramid

This philosophy may be an advantage to use with the UK guidelines, particularly with children. For example, in this project some of the children had one slice of bread as a sandwich whereas others had two. Using the simple allocation method devised in this thesis, both groups of children had a single portion in the cereals group. With the US guidelines, those children having two slices of bread would be considered as having two servings. This would alter the balance of the food groups in favour of the cereal, bread and potatoes group. Therefore, it may be more appropriate to follow the US model and include estimates of portion sizes if we are to use the food group database for individual dietary analysis.

Points to be considered for future work with prepubescent children in schools are that i) study opportunities within schools are limited by various factors such as timetable commitments and school holidays, ii) the children's continuing cognitive development and exposure to nutrition education may affect the responses given by the children at follow-up.

NAME: _____ CLASS: _____ Appendix A

MUSHROOMS

BREAD ROLLS

SPAGHETTI

SWEETCORN

CHEDDAR CHEESE

BURGER BUNS

BOILED POTATOES

CABBAGE

CHICKEN

BRANFLAKES

KIWI FRUIT

MILK

NUTS

WHITE BREAD

MACARONI

TOMATOES

COTTAGE CHEESE

PORRIDGE

PURE FRUIT JUICE

MASHED POTATOES

EGGS

WHITE RICE

STRAWBERRIES

SEMI-SKIMMED MILK

LEMONADE

WHOLEMEAL BREAD

BROCCOLI

CUCUMBER

MILKSHAKE

CORNFLAKES

ORANGES

SAUSAGE ROLL

MILK AND MILK PRODUCTS

BREAD, POTATOES AND OTHER CEREALS

FRUIT AND VEGETABLES

MEAT, FISH AND ALTERNATIVES

FATTY AND SUGARY FOODS

MUSHROOMS

ROAST LAMB

BROWN RICE

RASPBERRIES

YOGHURT

GREEN BEANS

HOTCROSS BUNS

JACKET POTATOES

BEETROOT

ANGEL DELIGHT

WEETBIX

APPLES

GREENPEPPERS

FISHFINGERS

PASTA

PEAS

STRAWBERRY YOGHURT

FLORA MARGARINE

MUESLI

BANANA

CAULIFLOWER

BEEFBURGERS

NOODLES

CARROTS

CUSTARD

CRISPS

RICE CRISPIES

GRAPES

CAKES

BAKED BEANS

CHEESE AND TOMATO PIZZA

3rd July 1996

Dear Parent(s),

We are researchers from the Medical Faculty at the University of Southampton. We are carrying out a study at your child's school to find out what today's young people are eating. This is important because what young people eat affects their health both now and in later life.

Your child's class is one of the ones chosen to help us find out how good their food recall memory is over 24 hours. We are writing to ask if you would note down on the attached form everything you know your child eats on Sunday 7th July. For our purposes we do not want the child to be aware that you are recording what they eat. Do not worry if you are unsure of anything they have eaten outside of the home, just note that they were out and record what you can.

As a classroom exercise we are going to be looking at diet on Monday 8th July. Your child will also be asking you a few questions about food on Sunday to use during the Monday session. Please would you put the form and answers to their questions in the envelope provided and send it back to the school with your child on Monday morning.

Thank you very much for your help.

Yours sincerely,

Kip Pirie
Senior Research Fellow

Dr Barrie Margetts
Senior Lecturer

Food record for (name):_____

	RECORD FOR SUNDAY 7th JULY 1996 Include all foods, drinks, sweets, etc., and the type of food, e.g. fried, low fat
From waking through to and including Breakfast	
During the morning	
Lunch	
During the afternoon	
Evening meal	
Between evening meal and bedtime	

Please put this in the envelope provided. THANK YOU FOR YOUR HELP.

Your (name):_____

	RECALL FOR SUNDAY 7th JULY 1996 Include all foods, drinks, sweets, etc., and the type of food, e.g. fried, low fat
From waking through to and including Breakfast	
During the morning	
Lunch	
During the afternoon	
Evening meal	
Between evening meal and bedtime	

THANK YOU FOR YOUR HELP.

Appendix E

10th January 1997

Dear Parent(s),

Researchers from the Wessex Institute for Health Research & Development, part of the Medical Faculty at the University of Southampton are carrying out a study at our school to find out what today's young people are eating. This is important because what young people eat affects their health both now and in later life.

Orchard Junior School takes part in the 'Healthy Schools' initiative which aims to provide sound information on healthy living. As part of the initiative we shall be working closely with the researchers to develop dietary assessment tools for young people. The majority of the work is part of the school curriculum and is incorporated into their lessons. However, part of the study has to be done outside the classroom and needs parental help and support. Your child's class is one of the ones chosen to help us during the Spring Term. We are writing to ask you whether you would agree to take part with your child. This is a crucial stage in the investigation and the information you give us will lay the ground work for the rest of the study.

If you agree, your child with your help will:

- Weigh and make a note of everything they eat and drink for a week in the booklet we will give them. We will lend them the scales and show them, and yourself, how to use them.

This information will be used by the children at a later date as part of a classroom exercise.

We will be holding an exhibition and explanatory session at the school before the start of the work. Should you volunteer to participate we will contact you by letter inviting you to the explanatory session. All the information given to us is strictly **confidential** and all names will be taken off the booklets at the end.

If you would be prepared to take part in the study please fill in the slip below and return it to school by Monday 21st October 1996.

Thank you very much for your help.

Yours sincerely,

Miss Lin Smith
Deputy Headteacher

Kip Pirie
Senior Research Fellow, University of Southampton

I would/would not be willing to help with the study. *(Delete as appropriate)*

Your name _____ Your child's name _____

Address _____

_____

_____

WESSEX INSTITUTE for HEALTH RESEARCH and DEVELOPMENT
UNIVERSITY OF SOUTHAMPTON

A Study of the Diet and Eating Patterns of Young People

Information for Parents

Why are we doing the study?

It is well known that diet has a major impact on health. There is much research into the effects on long-term health in adults but there is very little known about the affect of the diet of young people on their health in adulthood. But we need to know because their diet affects their own future health and also that of their children.

What is this study about?

This is the first stage of the study where you and your child will be helping me to develop a suitable food questionnaire to use with young people. This stage is crucial to the rest of the study and the information you give us will help with our future research.

Where are we doing the study?

Orchard Junior School have a very progressive attitude towards health and nutrition and have agreed to help with the study.

When will we be doing the study?

We will be doing the study during the Spring term and will feed back the results during the Summer term.

What will your child have to do?

Weigh and make a note in the booklet we will give them of what they eat for four days.

What happens afterwards?

We hope that the information we get from this study will result in a computerised questionnaire that can be used to get a better understanding of how the eating patterns of young people affects their well being and how we may prevent illness.

Who is doing the study?

We work in the Medical Faculty of Southampton University, based at Southampton General Hospital. If you would like further information about the study, please write to: Kip Pirie, Wessex Institute for Health Research & Development, Level B, South Academic Block, Southampton General Hospital. SO16 6YD.

Thank you for your help.

About Yourself

Please write on the line _____  *or tick the box* ☑

My name is _____

My date of birth is _____ **and I am** _____ **years old**

The place I live in is.....a house or bungalow ☐

a flat or maisonette ☐

a bedsit ☐

other _____

The place I live in is.....owned by my family ☐

rented from the council ☐

rented from a private landlord ☐

I don't know ☐

I live with my..... mum or stepmum ☐

dad or stepdad ☐

older sister(s) or stepsister(s) ☐

how many? _____

younger sister(s) or stepsister(s) ☐

how many? _____

older brother(s) or stepbrother(s) ☐

how many? _____

younger brother(s) or stepbrother(s) ☐

how many? _____

other people ☐

who?_____

What kind of work do your parent(s) do? Please write in what they do or if they are unemployed, retired or do house work.

My mum or stepmum _____

My dad or stepdad _____

 **The End**  **Thank you !**

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