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Pedro, Titilola Minsturat

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COMPARISON OF INDIVIDUAL FOOD ITEM INTAKES OF A TRUE LONGITUDINAL GROUP OF SOUTH AFRICAN CHILDREN AT FIVE INTERCEPTIONS BETWEEN 1995 AND 2003; THE BIRTH-TO-TWENTY (BT-20) STUDY

Titilola Minsturat Pedro

A dissertation submitted to the Faculty of Health Sciences,

University of the Witwatersrand, Johannesburg,

in fulfillment of the requirements for the degree of

Master of Science in Medicine

Declaration

I, Titilola Minsturat Pedro declare that this dissertation is my own work. It is being submitted for the degree of Master of Science in Medicine in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree at this or any other University.

Signed: _____

on May 25, 2006.

The work reported in this dissertation was performed in the Birth-to-Twenty (Bt-20) Research Program, University of the Witwatersrand, Johannesburg.

Dedication

To Almighty Allah, the All Knowing, who shows mercy to whom He pleases, and to my husband, who continuously encouraged and supported me, and never lost faith in me and to my lovely children, Omowunmi and Olanrewaju for their understanding and patience.

Publications and Congress Presentations arising from the Study

PUBLICATIONS

CONGRESS PRESENTATIONS

1. *18th International Congress of Nutrition, Durban 19-23 September 2005.*

   Pedro TM, Mackeown JM, Norris SA. Individual food item intakes of a true longitudinal group of South African children between 1995-2003 THE BIRTH-TO-TWENTY (Bt-20) STUDY.

ABSTRACT

Eating patterns change over time. Studies have been conducted in industrialized countries stating that it is important to study the longitudinal development of dietary intake itself and to determine the stability of this intake, but monitoring longitudinal dietary habits of the same children over a period of time, in particular with regard to individual food items, is severely limited in developing countries such as South Africa.

South Africa, a country with diverse cultures, is undergoing massive socio-economic and political changes, and an increasing social integration following the abolishment of the previous apartheid legislation. Obviously diet too must have been affected. The country is in a state of nutritional transition, and if the nutritional status of South African children is to improve in the 21^{st} century, basic knowledge is required of the actual food items the children have been and are consuming, and the change in consumption of these individual food items during this transition.

The Birth-to-Twenty (Bt-20) study is the continuation of Birth-to-Ten (BTT) study, which started in 1990 and plans to continue to 2010. It is the largest running cohort study on children's development in Africa and also the first and only longitudinal study on the nutrient and individual food item intake of South African children, living in the Johannesburg/Soweto area of the Gauteng Province.

This research will thus provide valuable, unique information on the individual food items consumed and change in consumption of these foods by South African children from the Bt20 study over an eight-year period (1995–2003).

The overall objective of this study was to determine the variety and change in consumption of individual food items consumed by a true longitudinal group of urban black South African children from the Bt20 study in 1995; '97, '99, 2000 and 2003 when they were 5, 7, 9, 10 and 13 years of age, respectively.

with the following sub-objectives:

- To determine the number of times each food item was recorded by the longitudinal group of children.
- To determine the percentage of children consuming the individual food items.
- To determine the mean weekly frequency of consumption of the individual food items for all the children, as well as for only those children consuming the items.

The study sample size comprised a true longitudinal group of urban black South African children (n = 143), from the Bt20 study that had nutrition information at all 5 interceptions (1995, 1997, 1999, 2000 and 2003).

Data were collected at each interception using the same semi-quantitative food frequency questionnaire. Parents/guardians or the children themselves were asked by trained multi-lingual interviewers to indicate how frequently the listed food items were consumed.

The food items were coded onto computer coding sheets using the South African Med-

ical Research Council's Food Composition Tables and Codes. Recorded or standard portions sizes were used based on the use of the National Research Institute for Nutritional Diseases(NRIND) Food Quantities Manual. The coded data were put on disk by a data capturing company and SAS was used for statistical analysis. Specific computer programmes were written to systematically re-arrange and merge the data by subject ID number. The final longitudinal sample with nutrition information at 5 interceptions was extracted by ID number as each child kept the same ID number for all interceptions.

Frequencies were calculated for:

1. The number of times each food item was recorded per week, firstly for all five interceptions combined and secondly for each interception separately. The total number times each food item was recorded for all five interceptions combined was divided by the total number of times all food items at all five interceptions combined (23840) were recorded and expressed as a percentage.

   The total number of times each food item was recorded at each interception separately was divided by the total number of children in the group [n=143] and expressed as a percentage.

2. The total weekly frequency of consumption for each food item. The mean weekly frequency of consumption for each food item was calculated for all the children in the group [n=143] for each interception separately (total weekly frequency of consumption of each food item/total number of children [n=143] and then only for those in the group consuming the food items (total weekly frequency of consumption of each food item/number of times each food item was recorded for

each interception.

The food items were ranked in descending order according to:

- their percentage contribution of the total number of times all food items at all five interceptions combined were recorded
- the average number of times recorded for all five interceptions combined
- the mean weekly frequency of consumption for all five interceptions combined.

The ranked food items were then arranged within the 8 food groups listed in the questionnaire (chapters 3, 4, 5).

Forty-one food items made up 1% or more of the total number of times all food items were recorded for all five interceptions combined. This was used as a cut-off point as all the other food items were recorded too infrequently to include. For this reason only these forty-one items will be discussed in chapter 3, 4 and 5 of this thesis.

A total of 546 different food items were recorded 23840 times between 1995-2003. The highest number of food items recorded was in 1999 (124) and 2003 (123) both almost 23% of the total number of food items recorded when the children were nine and thirteen years old, respectively. Of this, 41 items contributed 1% or more of the total number of recordings.

There was a decrease in the number of recordings from the grain and cereal group, fruits and vegetables and milk and milk products. However, among the meat and meat substitutes, the number of recordings for chicken and cheese increased over this time as did the number of recordings for margarine and ice-cream among the fats and oils. Among the miscellaneous group sugar, sweets, tea and carbonated beverages remained

fairly stable over the 5 interceptions, but there was an increase in the number of recordings for crisps and chocolates from 2000 to 2003.

Ninety percent or more of the children consumed rice, stiff maize-meal porridge, chicken, sugar, sweets and tea over the five interceptions.

Fourteen food items were consumed by 75% or more of the children and 33% of these 41 items were consumed by 50% or more. All the top 41 food items were consumed by more than 33% of the children.

Among grain/cereal group/breakfast cereal/porridges and other starches, the most frequently consumed food items were brown bread, stiff and soft maize-meal porridge, all being consumed between 4-6x/week for all the children as well as for only those consuming these items.

Peanut butter, eggs and chicken were the most frequently consumed items among the meat and meat substitutes, 3-5x/week for all the children and for only children consuming these items.

In the group of fruits and vegetables, fruit juice and mashed potato were consumed most frequently, but not everyday of the week either for all the children or for those consuming these items.

Within fats and oils food group, cooking oil and butter were consumed most frequently (3-4x/week) for all the children and 5x/week for only those children who consumed these items.

Full cream milk was the most frequently consumed food item (5-6x/week) among the group of milk and milk products for all the children as well as for only those consuming this item.

Among the miscellaneous food items sugar (5-6x/week), sweets and tea (4-5x/week) were the most frequently consumed for all the children and between 5-7x/week for only those consuming these items.

The dietary patterns of this longitudinal group of urban black South African children was far from the recommended South African Food-Based Dietary Guidelines (FBDGs), which was developed with the aim of making evidence-based nutrition and lifestyle messages to the public accessible, understandable, generalizable, acceptable in a cross-cultural context and feasible. Thus, this study has provided useful insights to guide the governmental parastatals, nutrition scientists and other interested cooperate bodies in promoting successful nutrition intervention strategies that will lead to healthy dietary habits among children and adolescents.

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Professor P.E. Cleaton-Jones, who gave me a wonderful welcome to his team and for his elderly advice during the study. *"Agba o ni tan ni ilu o."*

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My special thanks to all other staff members of the Birth-to-Twenty Study, without their efforts, this work would not have been possible and especially to members of the mobile team at Chris Hani Baragwanath Hospital and the Bone Health team at Wits Medical School, who conducted in-person interviews with the subjects.

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1. INTRODUCTION

1.1 Definition of nutrition

Nutrition is the scientific study of foods and the process by which it is digested and assimilated [1]. According to Murphy's study [2], "most kindergarten students defined nutrition as eating food that is healthful or good for you", which indicates a developmentally appropriate understanding of this term [2]. Thus, children as young as kindergarten age recognise *nutrition* in terms of food, not nutrients.

In addition, Navia [3], defines nutrition as a complex science that involves not only foods and diets, but also deals with the process of incorporating into the body essential compounds from the trophic environment that cannot be synthesized by human tissues [3]. These nutrients supplied to the tissues exert powerful influences as structural essentials for synthetic processes and as regulators of all biochemical reactions involved in body metabolism [4].

Many diseases related to nutrition, and food items in particular, have also been recognized for centuries [5], for example: scurvy could be prevented by eating green vegetables or fruits; night blindness was associated with the heavy dependence on pol-

ished rice as the major food; pellagra was associated with eating spoiled corn [6]. Thus foods, opposed to nutrients, were recognised as the cause/prevention of these diseases.

However, vitamins, minerals, amino-acids, fatty acids and other essential nutrients found in foods were discovered at the turn of the 20 ^{eth} century and proved very important in combating nutritional deficiencies. Thus, this accompanied the birth of nutritional science a decade ago [6] – [8]. Furthermore, explosive developments in molecular biology in the 1970's changed, and is still changing, our understanding about nutrition as a science and its relationship with other sciences [7] – [9]. Hence, there are many factors affecting the principles of adequate nutrition which is illustrated in Fig. (1.1), [10].

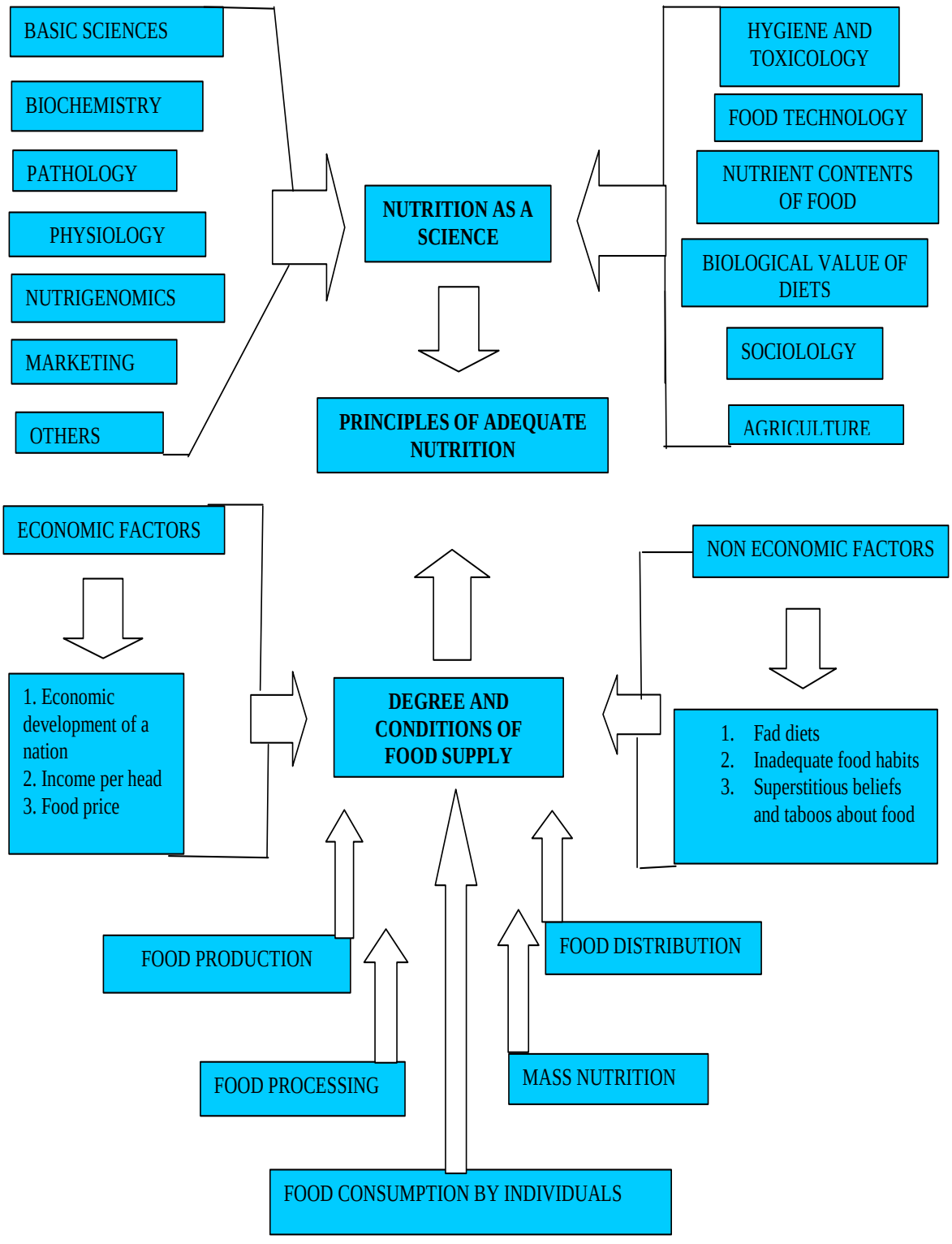


Fig. 1.1: Factors affecting principles of adequate nutrition.

Conclusively, the horizon of nutrition has broadened immensely since nutrition was thought to have been a completed science 30–40 years ago. Nutrition science has interwoven with other biological sciences and other disciplines. The need for interactions with other disciplines is greater now than ever before. Therefore, opportunities for new, imaginative, and exciting directions in the science of nutrition and the application of new knowledge in the practice of nutrition show no signs of abating [5] – [8], [11, 12].

A wealth of information provides much evidence of the universal role nutrition plays in all life processes [7], from the cataclysmic union of sperm and ovum, through intrauterine development, through birth, growth, maturity, and simultaneous decline and senescence, through disease and injury, until at last vital forces are overcome and all metabolic activity ceases, the process of nutrition is absolutely essential [12].

1.2 State of children's nutrition in Africa

Malnutrition includes diseased state due to:

- inadequate dietary intakes of nutrients such as total energy, protein, vitamins or minerals [13]
- excessive intakes of energy and/or particular nutrients [14, 15]

Malnutrition ravages millions of children in developing countries. Its survivors are left crippled, chronically vulnerable to illness, and intellectually disabled [9], [13] – [23]. As Walker and Walker [20], stated "Short stature due to malnutrition or illness is undesirable ... feeding children for maximum growth and physical development may not add to, and may indeed be harmful to their long-term health and longevity" [20].

Many children living in developing countries are undernourished [19, 22, 23]. Of greater concern are those living in Africa, where over half of the population in Africa are children, in contrast to Europe or America, where half of the population are adults [21].

A survey conducted on 3000 Birth-to Twenty (Bt20) children (79% black, 12% coloured, 6% white and 3% indian) revealed one in five among these children were stunted- an indication of persistent poor health and particularly inadequate nutrition during infancy [24]. According to the most recent South African census conducted in the year 2001 the black African population had an age profile typical of a developing country, with a relatively large percentage (34%) of the 79% of the total black African population being children under the age of 15 years [25].

Furthermore, a meta-analysis on South African studies revealed that 39% of the South African population is vulnerable to food insecurity, particularly the black community [14]. The study also showed that 22% of all children under the age of nine years are stunted due to chronic malnutrition and the rates of stunting among the population in Gauteng was 19% [14]. A study conducted in Johannesburg and Soweto of the Gauteng Province of South Africa [26] revealed that about 7% percent of South African children are overweight, which is twice the average percentage overweight for developing countries, and greater than the average percentage for Africa and the United States of America (USA)[27].

However, in a Soweto school, 25% of primary-school children were underweight with 1% severely malnourished, while 4% were overweight [28]. Interestingly, Richter [26] showed that 9.4% of 9-year-old Bt-20 children were stunted, and 14% were undernourished, which was the 10^{th} percentile for weight for age. Furthermore, 14% of the sample were overweight and 3% were obese [26]. Stunting and undernutrition differencially affect black children [13, 21, 26, 29].

National data from a food consumption survey in South Africa reported that children under the age of nine consume a diet deficient in energy and a number of micro-nutrients including calcium, vitamin A, iron, zinc, thiamin, ribiflavin, folic acid and vitamin B_6 [30].

Nutrient deficiency has negative consequences for the children's development because

they may never recover fully, especially from severe deficiencies [17, 22, 23] when they grow up and even when they revert to a more balanced diet [9, 14], [21] – [23], [31, 32]. Hence, they need sufficient intake of high quality diets to ensure optimal physical, social, and cognitive growth and mental development, and resistance to and recovery from infections [9, 33]. More so, childhood and adolescence are critical periods for individuals to lay a good nutrition foundation for their future health, and to prevent the onset of adult health problems [22, 23], [34] – [37]. Thus, primary preventive strategies initiated early in life are arguably the most promising way to face the epidemic of chronic disease [35, 36, 38, 39].

In addition, nutritional status of children in South Africa is currently at an important crossroad because both under-nutrition [14] and over-nutrition coexist [26]. The need for continuous assessment of nutritional status of these children is very crucial [14, 15, 26].

1.3 Basic nutritional requirements for healthy development of children

Basic nutritional requirements for healthy development of children should be based on attainment of adequate nutrients for growth and development [40]. This can be highly effective if individual food item intakes are considered. As stated by van Dam, [41], "people choose foods and combinations of foods rather than isolated nutrients". Thus, dietary change may be more readily achieved if recommended foods are compatible with existing patterns of food consumption [2, 41, 42].

Studies of the nutritional requirements of school children have been relatively neglected and has been extrapolated from studies of adults and infants [9]. As a result, several countries were motivated to develop specific food dietary guidelines to suit their populations because of the following reasons:

- disparities in food intake of populations
- food availabilities
- current massive global burden of diet-related diseases
- growing perception that nutrient-based dietary guidelines are not effective in promoting appropriate diets and healthy lifestyles [9, 43].

The basic American standards for nutrient recommendations (RDA) has been used extensively to assess the nutrients and status of individuals and populations for over 50 years. The RDA have become overly complicated according to Hegsted [44], hence they have been replaced by Dietary Reference Intakes (DRIs) for the development of future nutrient recommendations. The DRI is an umbrella term that encompasses four types of nutrient recommendations for healthy individuals and are as follows:

- AI- adequate intake
- RDA- recommended dietary allowance
- EAR- estimated average requirement and
- UI- tolerable upper intake [6]

Thus, dietary recommendations and guidelines for children should be viewed both quantitatively (recommendations) and qualitatively (guidelines) [45]. As stated by Hegsted [44] "the best dietary standard would be one that tells us what mix of food should

be put on the table to feed families or other groups. This would require consideration of other important materials in addition to the essential nutrients" and will definitely have positive impact on the quality of life. In view of this, the food guide graphics of various countries differ in their recommendations [46, 47].

As a result of these factors, the South African Department of Health have recently developed special South African Food-Based Dietary Guidelines (FBDG) aiming to promote optimal nutrition:

- for children aged 5 years and older
- for people without special dietary needs
- and for all "healthy" South African adults.

This is to encourage responsible eating habits; ensuring that all macro- and micro-nutrient requirements are met [47]. There are 10 clear and simple messages in the FBDGs for both rural and urban South Africans and it was formulated in such a way that all people in South Africa should grasp their meaning. In summary these guidelines are [48]:

- Enjoy a variety of foods
- Be active
- Make starchy foods the basis of most meals
- Eat plenty of vegetables and fruits everyday
- Eat dry beans, peas, lentils and soya regularly

- Meat, fish, chicken, milk and eggs can be eaten everyday
- Eat fats sparingly
- Use salt sparingly
- Drink lots of clean, safe water
- If you drink alcohol, drink sensibly

The Food-Based Dietary Guidelines (FBDGs) have been developed with the aim of making evidence-based nutrition and lifestyle messages to the public accessible, understandable, generalizable, acceptable in a cross-cultural context and feasible. Furthermore, these messages are formulated to be positive rather than punitive or negative [49], as stated in the first guideline "Enjoy a variety of foods", the word "enjoy" means to be happy or satisfied and to like the food because of those households with food insecurity, signifying that people should be grateful for having food [11, 14].

Dietary diversification has been advocated internationally, also in South Africa on the basis of the need to consume more than 40 different essential nutrients despite incompleteness of nutritional knowledge which is expanding continuously both in terms of nutrients and non-nutrients present in foods [10, 11]. For avoidance of monotonous diets, the first FBDGs suggests altering the method of food preparation as another means of increasing dietary variety for households where there are few foods available [11].

Good nutrition and physical activity are essential for the long-term health of children [33, 50] and the importance of physical education has been recognized nationwide,

particularly for growing children, in lowering risk of all cause of mortality, as well as morbidity associated with many chronic diseases of lifestyle [49] – [52]. Physical activity is thus bodily movement produced by the contraction of muscle and substantially increases energy expenditure above the basal level [53, 54].

The second guideline "Be Active" addresses the issue of the increasing burden of chronic diseases in the South African population and for protection against these diseases of affluence. Regular physical activity lowers serum triglyceride concentrations, improves tissue sensitivity to insulin, increases fibrinolytic activity, decreases clotting activity, increases high density lipoprotein (HDL) cholesterol concentrations and lowers blood pressure [49]. Furthermore, in many instances physical activity increases bone mineral density, and helps to maintain a healthy body weight especially for growing children [49] – [51].

The Bt-20 study indicated that about sixty percent of young black children attend schools at which no formal physical exercise or sport is available. This is a situation which may further condition activity levels, diet, weight gain and risk for disease [26]. These children need physical activity for better development and for prevention of adult onset diseases.

The third on the food guide "Make starchy foods the basis of most meals" is practical, culturally sensitive, affordable and sustainable because worldwide, especially in developing countries, starchy or high carbohydrate foods are the most important sources of food energy and they are relatively cheap [9, 55]. Hence, the third guideline recommends:

- at least 55% of total energy should be provided by a variety of carbohydrate sources to protect against chronic diseases (leaving a maximum of 30% for fat and 15% for protein).

This together with increased intakes of fibre, resistant starch and associated plant substances will decrease the risk of many overnutrition - related diseases, non-insulin-dependent diabetes mellitus (NIDDM), and some forms of cancer. In addition, the contribution of micronutrients to the diet by unrefined and fortified cereals and grains will help to prevent micronutrient undernutrition. Therefore, starchy foods have direct, indirect or "replacement" effects on nutritional status and health [55, 56].

The fourth guideline: "Eat plenty of vegetables and fruits everyday", is in support of history and civilization across the world which have recognized the use of plant material to improve health. Of these plant food groups, vegetables and fruits are the most botanically diverse [56] – [58]. There are probably many other active substances in vegetables and fruits which are yet unknown and the interactive and synergistic effect of nutrients in food cannot be discounted. Vegetables and fruits are rich sources of a variety of nutrients, including vitamins, trace minerals and dietary fibre, and many other classes of biological active compounds [58].

Vitamin A is essential for vision, needed for development of the bones and skeleton while vitamin C, an antioxidant helps to maintain the connective tissue protein collagen. Vitamin C also protects against infection and helps in iron absorption [59]. Thus, the potential roles of these two vitamins are very crucial for the the growth and development of children.

Potential disease-preventive mechanisms of vegetables and fruits and their constituents as identified in human dietary studies are listed below [58]:

- Antioxidant activity
- Modulation of detoxification enzymes
- Stimulations of the immune system
- Decrease in platelet aggregation
- Alteration in cholesterol metabolism
- Modulation of steroid hormone concentrations and hormone metabolism
- Blood pressure reduction
- Antibacterial and antiviral activity

Thus, vegetables and fruits have protective roles in relation to many diseases, such as cancer, coronary heart disease, infections, cataracts, and cardiovascular disease; and their protective role is difficult to assign to any specific nutrient [9, 58].

"Eat dry beans, peas, lentils and soya regularly" as the fifth guideline has scientific merit and in addition they are easily available. The scientific advantages are that legumes (also known as pulses), are rich and economical dietary sources of good quality protein, carbohydrates, soluble and insoluble dietary fibre components and a variety of minerals and vitamins, and pulses have low energy, fat and sodium content. Hence, the inclusion of legumes in a health-promoting diet is important in meeting the major dietary recommendations to improve the nutritional status of undernourished as well as overnourished South Africans, and to reduce the risk for chronic diseases such as

cardiovascular disease, diabetes mellitus, cancer and osteoporosis [60].

The sixth guideline is devoted to "Meat, fish, chicken, milk and eggs" as part of a variety of foods and it is stipulated that these foods can be eaten everyday. Some studies have shown that nutritional adequacy of the diet increases with a greater number of different foods: such diets tend to include less protein, meat, and meat alternatives and more carbohydrate, fruits, and vegetables [6, 9, 61]. Research has shown that balanced diets can be achieved without meat, fish, chicken, milk and eggs but inclusion of these foods in the diet will help meet nutrient needs. Therefore, it is recommended that optimal amounts of these foods should be eaten where possible and economically feasible because, compared with plants foods, these foods are relatively expensive and economic circumstances often dictate intakes [61, 62]. Thus, the South African FBDGs recommend:

- 400-500 ml milk, or equivalent daily, especially low-fat milk and milk products.
- Two to three fish dishes per week, preferably dark fatty marine fish such as mackerel or pilchards.
- About four eggs per week, preferably to replace the 'meat' serving (red meat and chicken).
- Not more than 560g red meat per week (approximately 80-90g per day), emphasizing low-fat types and cuts [61].

Iron, calcium and zinc play very important roles in the growth and development of children. According to Sizer [59] "iron is clearly the body's gold, a precious mineral to be hoarded". It is an essential nutrient recognized for more than a century due

to the world's most common nutritional deficiency disease- iron deficiency anemia [6]. Calcium makes up bone and tooth structure and zinc affects behavior, learning and assists in immune function [59].

The fat requirements of children can be judged according to four criteria:

- the possible obligate needs of fat as a metabolic fuel,
- the provision of a sufficient energy-dense meal to meet energy needs,
- the adequate supply of essential fatty acids, and
- the supply of sufficient fat to allow adequate absorption of fat-soluble vitamins [63].

The guideline, "Eat fats sparingly" embodies the recommendation that fat should be eaten (addressing undernutrition), but that it should be used sparingly (overnutrition). A moderate-fat diet, providing less than 30% of total energy is recommended for the prevention of chronic diseases of lifestyle [64]. Therefore, South Africans are encouraged to lower their fat intake from animal sources and non-dairy creamers, and to consume unsaturated tub margarine and oils instead of hydrogenated fats and animal fats. Many scientific bodies suggest that children older than two years are the same as adults [64]. Therefore, it is recommended that fat as a percentage of total energy should be consumed as follows: saturated fatty acids (SFAs $< 10\%$), monounsaturated fatty acids (MUFAs $> 10\%$), polyunsaturated fatty acids (PUFAs$<10\%$), and dietary cholesterol of 300mg/day [6].

The eighth guideline suggests: "Eat Salt Sparingly"- Sprinkle, Don't Shake. This is to support the hypothesis that an excessive salt intake leads to increased blood pres-

sure in genetically susceptible persons and if a high intake is maintained long term, hypertension may develop. It is recommended that salt should be used sparingly, if at all, at the table and in the preparation of meals, and the intake of processed foods high in salt should be limited [65].

Water is an essential component of the human diet which is required to maintain the hydration of tissues and the composition of the extra cellular fluid compartments of the body [9, 66]. Hence, the guideline to 'drink lots of clean, safe water' is a unique but very important one for South Africans, living in such a hot and relatively dry climate. In addition, replacing less nutritious beverages with those that are more nutrient-dense or represent more healthful choices such as milk, water, or 100% pure fruit or vegetable juice would be of great help to the overall health of children [67]. Thus, the SAFBDGs recommends a daily intake of up to 2litres/day of 'safe, clean' water desirable for optimal hydration, and may be taken in the form of tap water, beverages such as tea and coffee, and other tap water based-drinks [66].

The last South African FBDGs, "If You Drink Alcohol, Drink Sensibly" focused on the intake of alcohol which has a long history and an ingrained part of human life. Its abuse has many detrimental health, social, lifestyle and economic consequences. The guideline strongly recommends that children should abstain from alcohol use [68].

According to Anderson, "science-based dietary guidelines are designed to provide guidance on the composition of a healthy diet and if these guidelines are isolated from food-based information and strategies for the target population, they are not likely to

succeed" [43]. In summary, to gain full benefit from dietary recommendations, and for prevention of adult-onset diseases, good and sound nutrition should begin in childhood and be maintained throughout adolescence and adulthood [69].

1.4 Factors affecting children's food item intakes

Food intake, in comparison to nutrient intake, is a complex behavior affected by a web of factors: culture; personal environment; school environment; peers; food industry and fast food environments; media and entertainment environments; and non-supportive social conditions, particularly with growing children [70, 37], illustrated in Fig. 1.2.

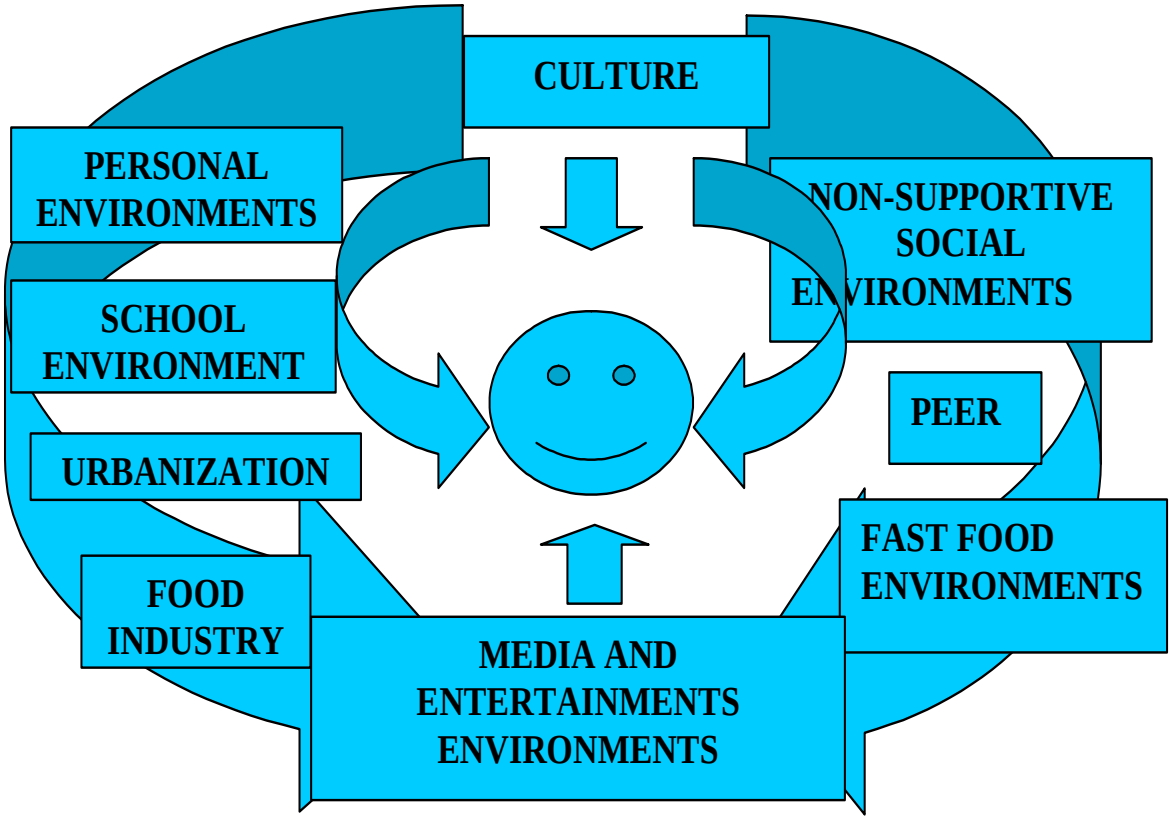


Fig. 1.2: Factors affecting children's food item intakes.

Like many other behaviours, children's eating patterns are largely learned. Starting from infancy, a child learns what is edible and what is not, what is appropriate within the culture and the family regarding food etiquette, what types of foods are liked and disliked, and what cues are important in controlling food intake [6, 71].

In this respect, school children are highly motivated to explore their environment, to gain new experiences about food choices rather than nutrients and to exert independence on intake of certain food items [71].

1.4.1 Culture

Cultural traditions about food are continually changing over time, so children are destined to accept and consume the diet specified by their culture. These cultures keep evolving as people move about, learn about new foods, and teach each other [72]. Hence, culture can be defined as shared ideas, beliefs, knowledge and practices which form the basis of social interaction of a population [59].

1.4.2 Personal environment

Parents play a very crucial and vital role in shaping their children's eating habits in a variety of ways: through the environment and through the choice of children's eating method, by the foods they make available and accessible, by direct modeling influences, by the extent of media exposure in the home and by the way they interact with children in the eating context [73]. Furthermore, parents also influence the variety, frequency, and macronutrient composition of foods that are served to children through

food purchasing decisions and preparation [74]. In this regard, parents play five major roles when it comes to a child's eating habit:

- provider,
- enforcer,
- protector
- role model, and
- advocate [53].

1.4.3 School environment

The school environment can be defined as a learning environment where children and pre-schoolers spend between 6 to 8 hours per day [75]. Teachers, food service and child nutrition employees who teach children and manage programs become surrogate respondents about a child's eating behavior. Hence, the type of meals, snacks available at schools and the cost, all play important roles in developing children's eating patterns [33, 76, 77]. Thus, a healthy school environment provides the skill and support they need to adopt healthy eating behaviors, to obtain a positive nutritional status and to achieve academic success [37, 77, 78].

1.4.4 Peer

Older siblings and peers have a very strong hold on growing children. They become positive or negative role models. Children are easily influenced from their peers' food intakes, especially snacking at school and when eating out. This may contribute to the

intake of less nutritious and energy dense food [6, 9].

1.4.5 Urbanisation

Over the past two decades, the pace of urbanisation accompanied with change in dietary patterns and lifestyle have accelerated in developing countries, such as South Africa. Many South Africans are experiencing rapid urbanisation and acculturation, characterized by nutrition transition [48, 79, 80], particularly the increasing influx of predominantly African people from the relatively underdeveloped rural areas to the highly developed and industrialized urban areas [81, 82]. This has resulted in improved socio-economic status and access to a changed and wider varieties of foods [39]. However, the majority of published research from the third world countries have shown the emergence of western dietary patterns with increasing urbanisation among these peoples, to be associated with non-communicable diseases (NCD) such as coronary heart disease; obesity; cardiovascular disease; hypertension and dental caries [9, 16, 39, 79], [83] – [84]. Thus, continued research is essential with respect to this nutrition transition and change in food intake.

1.4.6 Food Industry and Fast Food Environments

Over time and in interaction with their social environments, children's food intakes are modified by accessibility of foods: state of the food industry of the nation; the massive exposure of food vendors; display of the food and the presence of fast food restaurants [10, 73], [85] – [87]. Consumption of fast foods have been attributed to excessive weight gain of children, due to large portion sizes, palatability, and high energy-dense food

sales in the fast food outlets [88, 89]. Globally, this has, and is still, contributing to children's food item intakes.

1.4.7 Media and Entertainment Environments

As stated by Story [37], youth live in a media saturated environment and one potent force is food advertisement particularly on the television [37]. Television is a pervasive purveyor of culture, providing children with a wide array of models and messages about eating that can influence negatively on children's food preferences and food selection [73]. Television exerts four major kinds of negative impacts on children's nutrition: First, television viewing requires no energy and secondly, it consumes time that could be spent in energetic play. Watching television correlates with between meal snacking and with buying and eating the energy dense foods most heavily advertised on children's programs and lastly; it encourages food behaviors that damage dental health [59, 90]. The majority of these heavily advertised items on children's television programs are low-nutrition junk foods. Thus, children receive more information about food, nutrition, and health from the media than from any other source. Children's requests for foods appear to be related to the frequency with which children see the foods advertised on television [37, 52, 73], and several studies have found that the majority of these advertised items are for foods high in fat, sugar and/or salt [37, 90].

1.4.8 Non-Supportive Social Conditions

In today's world, many populations exist under conditions of great social and economic disadvantages with poverty, malnutrition, disease [13], and overcrowding indicative of a

spectrum of misery composing the environment within which millions of children grow into adulthood [13, 91]. Furthermore, a number of economic influences on food choices have been identified. These include considerations of family structure and economy. As many children live in single-parent households or homes with two working parents, the economy of time becomes a major consideration in the types of foods prepared for children. Other concerns in this category include income and the amount of money available for food purchase [6, 13, 42, 87].

While it is generally agreed that children's food item intakes are influenced by personal and environmental factors, it is clear that research intervention should consider not only nutrients but should reinforce more on the actual foods that provide them. More so, measures of intake of foods probably reflect exposure to dietary risk factors better than measures of single nutrients [92].

1.5 Longitudinal Studies

1.5.1 Definition

Longitudinal is a broad term according to Ruspini [93] and can be defined as research in which:

- data are collected for each item or variable for two or more distinct periods,
- the subjects or cases analyzed are the same, or at least comparable, from one period to the next, and,
- the analysis involves some comparison of data between or among periods [93]

It is food intake over time that influences the nutritional status; hence, longitudinal research studies assessing food intake of the same individuals is essential. Developing countries are experiencing rapid urbanisation, therefore the importance of longitudinal nutrition studies is very crucial in monitoring the changing dietary habits of children in order for their future health.

1.5.2 Longitudinal Studies on food item intakes in European Countries

In Europe, longitudinal studies monitoring food and/or nutrient intake of children have been the subject of research for several decades. A cohort study by the British National Survey of Health and Development has been following 5,365 children born in 1946 to adulthood. The dietary intakes of these subjects were analyzed when they were 4, 36, 46 and 53 years old. It was reported that there were social and regional differences in food as well as in nutrient intake of these children at the age of four [94]. The children from manual workers consumed less fruits and vegetables.

Other countries in Europe started longitudinal studies investigating food and/ or nutrient intake of children in the 1970s. These include The Amsterdam Growth and Health Longitudinal Study, which has been examining the effects of rapid and slow maturation in adolescents on the development of obesity since 1977. The energy and nutrient intake of some of the subjects were measured repeatedly for 20 years and it was reported that the diets of these children remained stable over time [36, 95].

The DONALD study monitored fifteen-year trends in energy and macro-nutrient intake in German children and adolescents. Results of this study indicated that there was a slight increase in the consumption of bread, cereals, pasta and rice over the 15

year study period. The total food intake increased due to higher intake of beverages, but there was a reduced intake of meat, fish and eggs, indicating that dietary patterns had changed over time [96].

The French longitudinal study of growth and nutrition showed that the diets of children monitored from 10 months to 16 years were not meeting the required recommendations, especially with regard to carbohydrate, fats, calcium, and the intake of some other micronutrients [97].

It is now widely acknowledged that a country's diet tend to relate to the nation's degree of affluence [9, 98], and according to many authors from European countries, dietary patterns of children have changed but are far from optimal [9, 36, 38, 96, 97, 99]. Generally, there are improvements in food/nutritional intakes of Europeans, but consumption of starchy foods has increased with a tremendous increase in consumption of animal protein, fatty and sugary food items, but a decrease in vegetable consumption [9, 94, 100]. The outcome of these investigations have given increasing evidence that many present diseases may be related to diet [36, 38, 96, 97] [100] – [102].

1.5.3 Longitudinal Studies on food item intakes in America

Longitudinal studies on food item intakes of US children have also been the subject of research for many decades. During the 1970s, two national surveys of dietary intake began: the National Health and Nutrition Examination Survey (NHANES) and the Nationwide Food Consumption Survey (NFCS). These surveys represented a repeat of cross-sectional data sources for children's eating habits. Another longitudinal study,

which started in 1973, and is still continuously monitoring US children eating habits with respect to coronary heart diseases and hypertension, is the Bogalusa Heart Study [102].

A study by Albertson [103] revealed that energy and macronutrient intakes of American children examined in 1978 and 1998 remained fairly constant within a ten-year period. The average daily vitamin and mineral intakes were lower in 1988 than in 1978 and most of the nutrients recorded for the majority of the sample exceeded the RDA. The results also showed that intakes of calcium, vitamin B6, and zinc were below the RDA for more than 50% of the subjects [103]. However, there was no information on the actual food items consumed.

With regard to the actual food items consumed, the Bogalusa Heart Study showed that children consumed less milk, vegetables, soup, bread, grains and eggs, while there was an increase in the total amounts of fruits and fruit juices, carbonated beverages, poultry, and cheese over time. The report showed that the percentage of total fat from poultry, cheese and snacks had increased but had decreased from milk, fats/oils, pork, eggs and desserts [104].

Of the 107 food items examined by Smiciklas-Wright in the Continuing Survey of Food Intakes by Individuals (CSFII) in the 1989-1991 and 1994-1996 interventions, larger amounts of soft drinks, coffee, tea, and ready-to-eat cereal were reported in 1994/1996 than in 1989/1991. Smaller amounts were reported for foods such as margarine, mayonnaise, chicken, macaroni, cheese and pizza in 1994/1996 than in 1989/1991 [105]. It

was noted that among the American children and adolescents participating in the Continuing Survey of Food Intake by Individuals(CSFII) 30.3% of the sample consumed fast food. The children who ate fast foods reported higher added sugars intakes, less milk, fewer fruits and non starchy vegetables [88], generally a diet of poor nutrient quality. However, another study by Popkin [106] examining the rapidly changing 30-year trends in U.S. dietary intake concluded that diet quality had improved across both race and socioeconomic status grouping between 1965 and 1996.

In summary, the aim of early nutrition researchers was firstly to address the optimal recommended dietary allowances for children and secondly, to monitor dietary intakes among US children in order to explore and possibly prevent the onset of adult problems [6, 9, 102, 107]. Hence, extensive data collected from longitudinal studies in the United States revealed that dietary habits do change over time [88, 103] [105] – [108].

1.5.4 Longitudinal studies on food item intakes in Developing Countries

Studies have been conducted in industrialized countries about the importance of longitudinal intake of foods and/ or nutrients among children and monitoring the stability of their intakes to prevent the onset of adult health problems [36, 96, 100, 107]. However, monitoring longitudinal dietary habits of the same children over a period of time, in particular with regard to individual food items, is highly sparse in developing countries such as South Africa.

The recognition to start nutrition research on South African children began in earnest

in 1959 by the National Nutrition Research Institute of the South African Council for Scientific and Industrial Research(CSIR). It was suggested that dietary surveys of infants and young children should be carried out regularly in South Africa [109, 110].

Early nutrition intervention on food intake among the black community in South Africa was directed on their dietary habits, taboos about food and on nutrition and diseases with several authors reporting maize meal to still be the staple food among the black community. Additional foods included dried peas, beans, groundnuts, wild vegetables and fruits [30, 45, 109, 111].

In Africa a longitudinal study conducted in Kenya on school children from the age of 7 to 9 years and a subsample 12 to 14 years revealed that maize was the main dietary staple and millet and sorghum were used occasionally. Beans, green leaves and other vegetables were eaten with maize.The use of cow's milk was used only with tea or for infant feeding. It was also mentioned that eggs, meat or fish were rarely consumed. Thus the energy intake of the sample was between 75% and 80% of the recommended energy intake [112].

A recent survey of children aged 1-9 years (The South African National Food Consumption Survey) revealed that the average number of foods consumed daily based on the 24hr recalls in low income households nationally was 8 and varied from 4 in the Free State Province of South Africa to 13 in the Western Cape Province, indicating a low dietary variety and maize meal and other foodstuffs such as white and brown bread, rice, white sugar, tea, full cream milk, brick margarine, potatoes and non-dairy

creamers were popular among people of low economic status [30].

Investigators have also studied the relative contribution of individual food items to the total amount consumed by South African children [113] and the contribution of specific food groups to the energy and macro-nutrient intake of preschool children [114, 115, 116]. However, none of these studies have been conducted on a longitudinal sample, but the changes in nutrient intake of urban black South African children of the same age group, community and living in the same area, in the Gauteng Province of South Africa were identified by Mackeown *et al* [117], as well as the change in nutrient intake among a true longitudinal group of urban black South African children at four interceptions between 1995 and 2000, but to date no South African study has investigated the intake of individual food items among a true longitudinal group.

This study is the only longitudinal study conducted in South Africa that has identified the actual food items consumed by the same children over time.

However, similar birth cohort studies in developing countries are the Pelotas birth cohort study in Brazil [118] and Cebu longitudinal Health and Nutrition Survey conducted in the Phillipines by a team of researchers from the United States and the Philippines [119]. Both studies started in 1983. The Pelotas followed children to 2001 and the Cebu longitudinal Health and Nutrition Survey planned to follow the children till the age of twenty-five. However, these studies did not track nutrient and /or food intake over time.

There are thus substantial gaps in the information on longitudinal studies on food item intakes in developing countries because:

- following cohorts overtime is costly and difficult
- needs adequate manpower
- requires careful attention to cohort maintenance and attrition, together with ongoing analysis of the characteristics of cases who remain in the cohort and those who leave [32, 45, 120].

Hence, the success of any survey of a community depends greatly on the cooperation of the members of that community [121]. This study will thus provide unique information on the individual food items consumed by a true longitudinal group of South African children.

1.6 Conclusion to Literature Review

It is important to continue longitudinal nutrition research because "dietary habits and nutrition behavior are dynamic and constantly changing; with or without supportive environmental modifications" [122]. The fundamental approach to nutrition research is to identify individual food items consumed. It is the individual foods that supply the nutrients and the individual food items that will have to change to improve the nutrient intake and ultimate health of the population.

1.7 Objectives

The overall objective of this study was to determine the variety and change in consumption of individual food items consumed by a true longitudinal group of urban

black South African children [n=143] from the Bt-20 Study at 5 interceptions; 1995, '97, '99, 2000 and 2003, when they were 5; 7; 9; 10 and 13 years respectively, with the following sub-objectives:

- To determine the number of times each food item was recorded by the longitudinal group of children.
- To determine the percentage of children consuming the individual food items.
- To determine the mean weekly frequency of consumption of the individual food items for all the children as well as for only those children consuming the items (Fig. 1.3).

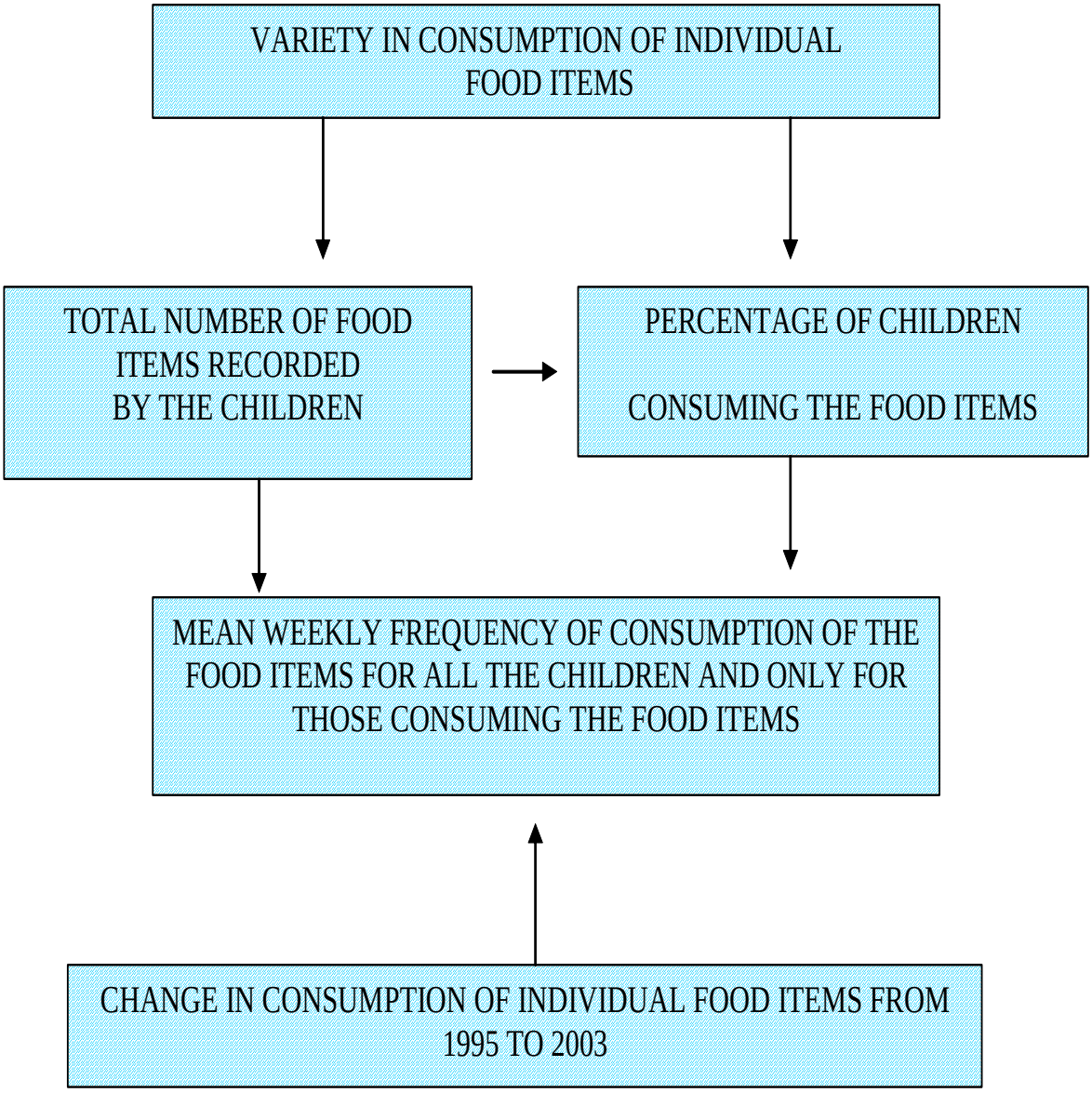


Fig. 1.3: Objectives of the study.

2. MATERIALS AND METHODS

2.1 Methodology

The methodological procedures used in this present study were in accordance with standards of the Ethical Committee of the University of Witwatersrand Committee (medical) for Research on Human Subjects. This committee reviewed, approved and gave the candidate a clearance certificate to do additional nutritional assessment in 2003. The protocol number is M03-05-81 (Appendix A).

The data used for this thesis were from the Birth-to-Ten (BTT) Study and Bt-20 Study, a continuation of the BTT study.

2.2 Birth-to-Ten Study (BTT)-an overview

The BTT study, following urban South African children from birth to 10 years of age, began in 1990 and continued to the year 2000. The overall aim of this study was to determine the biological, environmental, social, economic, and psycho-social factors that are associated with the survival, health, well-being and lifestyle of urban South African children [28, 82] living in South Africa's largest metropolitan area of the Gauteng Province; the Johannesburg/Soweto area. It was initiated to ensure that the impact of urbanisation was predominantly positive and that future policy be based on epidemiological evidence rather than ideology or tradition. Thus, it was an observa-

tional, interventional study that hoped these children of the 90's would provide baseline knowledge that would contribute to an improved quality of life for South Africa's urban peoples for the foreseeable future [28].

2.2.1 Study Population-BTT Study

The BTT study consisted of singleton births occurring during the 7-week period between 23rd April and 8th June 1990. Children (n = 4029) born during this period were identified through antenatal clinics and birth records. Participation in this study was limited to permanent residents within the Johannesburg/Soweto area. This is the commercial hub of South Africa in the Gauteng Province, covering about 200 square kilometres and, at the start of the study, included close to 3.5 million people with about 400 000 informal housing units [26]. The map of the Johannesburg metropolis is shown in Fig. 2.1 and Soweto is clearly indicated where most of the children resided.

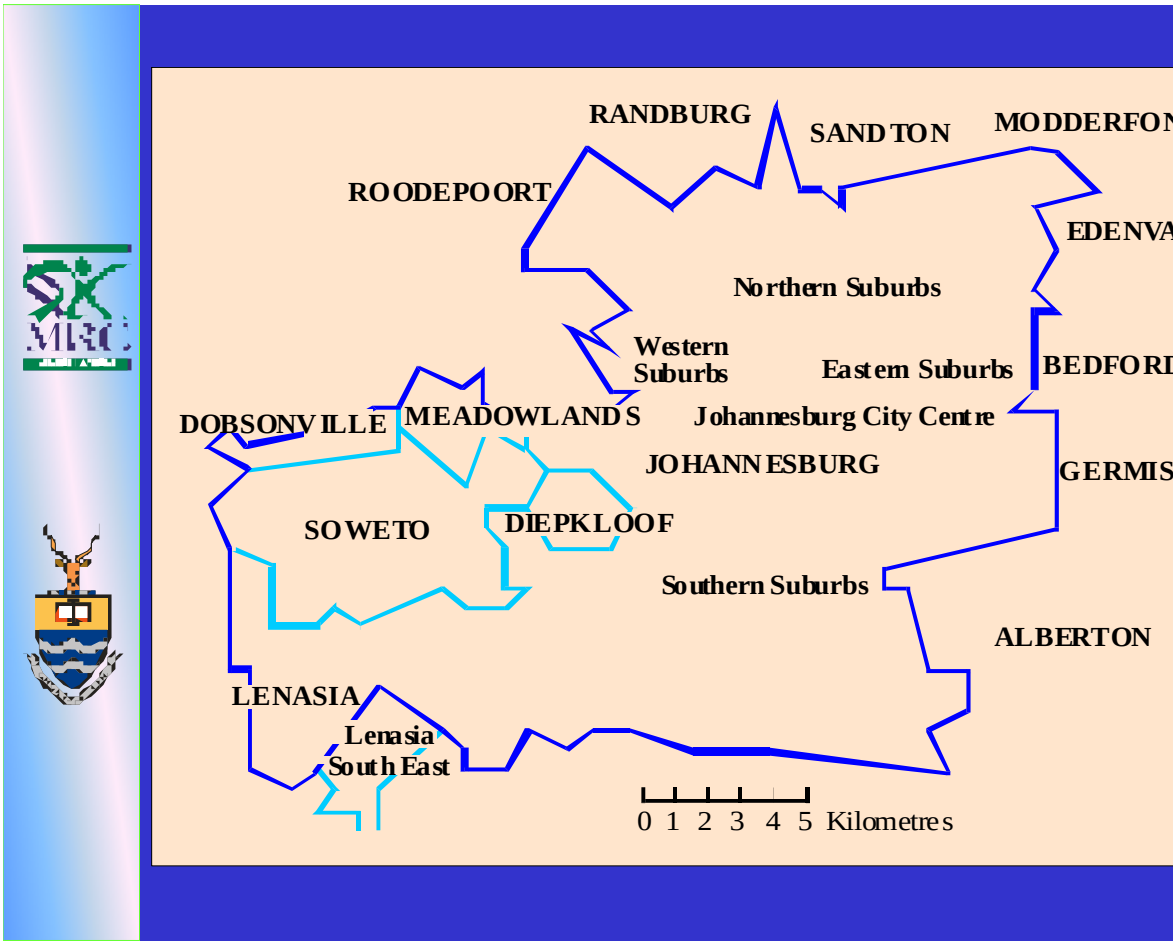


Fig. 2.1: Map of Johannesburg/Soweto Metropolis.

Levels of enrollments varied according to population group, residential area and place of delivery. Seventy-eight percent of all births in the black community within the prescribed time frame were enrolled, 86,5% from the "coloured" community, 69,5% from the Indian and 38% from the white communities. In this way, the original sample included persons classified under the Apartheid system as black (persons descended from the original inhabitants); "Coloureds" (persons of mixed heritage which involved some combination of the other groups); Indians (i.e descendants from immigrants from South Asia or the Indian subcontinent) and white(e.g English, Afrikaans-speaking, Jewish and other European ancestry)[123].

According to the most recent census survey in South Africa, Gauteng province has experienced the largest population growth between 1996 and 2001 with an increase of twenty percent for all communities. Thus, in terms of population numbers, KwaZulu-Natal province ranked first with 9.4 million, followed by 8.8 million in Gauteng province of the total 35.4 million black South Africans. Furthermore, black Africans are more than three-quarters of South Africa's total population with 79% (35.4 million), while whites made up only 9.6% (4.3 million), "coloured" 8.9% (4 million), and Indians/Asians 2.5% (1.1 mllion) [25].

The sample size of each community was based on a representative proportion sample of the total South African population. Hence, there was a large difference in numbers between the communities. The black community predominates in South Africa, making up 79% of the total population according to the 2001 census [25]. This fact, together with available number of children as core sample size resulted in adequate numbers for

the longitudinal investigation only from the black community.

2.2.2 Nutrition interceptions of the BTT Study

Nutrition information for the BTT study was collected in 1995; 1997; 1999 and 2000 when the children were 5; 7; 9 and 10 years of age respectively. A total of 1096 from the urban black children provided nutrition information for 1995, 505 for 1997, 304 for 1999, 365 for 2000. Of these, 163 urban black children made up the true longitudinal cohort of the BTT Study over ten years. The most common reason for attrition was movement out of the study area, but detailed follow-up and renewed contact was re-established resulting in an increased number of children in the year 2000 [32].

2.3 Birth-to-Twenty Study (Bt-20)-an overview

The Bt-20 is a continuation of the BTT study from the year 2000. This Bt-20 study was based on a series of guiding principles that has developed into nine main objectives listed as follows:

- Nutrition and growth of children and adolescents
- Cognitive and social development and adjustment
- Family life and the care of children and young people
- Education processes and outcomes
- Housing and neighbourhood environment
- Marker's determinants of health and illness
- Sexual and reproductive maturation

- Bone health and long term skeletal development
- Methodology issues involved in studying children [124]

This study, which will be further referred to as the Bt-20 study in this thesis is the largest and longest running study on children's development in Africa. It is also the first and only longitudinal study on the nutrient and food item intakes of South African children.

2.3.1 Study population and Nutrition interceptions of the Bt-20 Study

Nutrition information was collected in 2003 from 143 urban black children from original 163 longitudinal cohort in the BTT study. These subjects thus had nutrition information at all five interceptions. Therefore, the study population for this dissertation is a true longitudinal cohort of 143 urban black South Africa children from the Bt-20 study with nutrition information for 1995, 1997, 1999, 2000 and 2003 when they were 5; 7; 9; 10 and 13 years respectively. Figure 2.2 shows the number of children with nutrition information at each interception of the Bt-20 study.

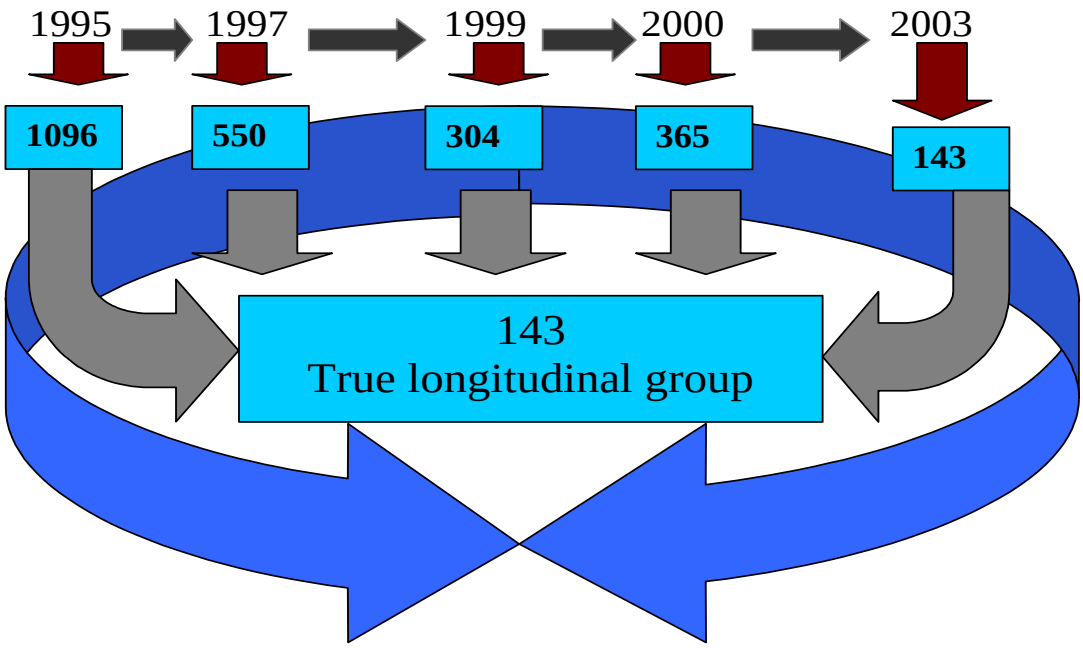


Fig. 2.2: Longitudinal group of urban black children for 1995; 1997; 1999; 2000 and 2003 with nutrition information.

This research work will thus provide valuable, unique information about the change in individual food items consumed by a true longitudinal group of black South African children over an eight-year period (1995-2003).

2.4 Dietary Methodology

Nutrition assessment methods used specifically for young children have evolved from Hasse's study of Swiss and Russian girls in 1882 to Burke's development of the diet history to the Ten State Nutrition Survey. However, there has been growing awareness of the sources of bias in any measure of diet [102], as stated by Barret-Connor [125]: "No method is universally the best", particularly dietary studies in children which have additional dimension of difficulties because the age of the group studied influences the methods used.

Different methods have been used in collecting dietary patterns of urban South African populations, examples are modified diet history, quantitative interviews, 24-hour recalls of habitual food intake, and 24-hour food frequency questionnaires of traditional foods [81]. However, epidemiological studies of food habits and dietary intake in infancy and childhood face a number of difficulties, which are more or less specific for these ages [126].

Further, dietary intake techniques in children tend to suffer from the general limitation that they involve an interview approach and, thus, they often rely on the child's parent to recollect daily intake accurately [54].

Besides these difficulties, the most frequently used methods for nutritional studies of school children were the 24-hour recall [30, 127] dietary history [113, 128], or a combination of both [129]. The most recent study on a representative sample of South African children used both the 24-hour recall and quantitative food frequency ques-

tionnaire [30]. Epidemiological research has given convincing evidence that the use of two to three methods provide more information than using one method, particularly in culturally diverse populations. The semi-quantitative food frequency questionnaire is one of the most widely used methods when the aim is to study a large number of subjects in a culturally diverse population. This method was validated by Margetts *et al* [130], and a quantitative food frequency questionnaire has been found to be reproducible, relatively valid and culturally sensitive in assessing the dietary intake of adult black South Africans in the North West Province [81]. Thus, this appeared to be the most appropriate method for the BTT and Bt-20 studies [130, 131, 132, 133] and was the method of choice in assessing dietary patterns of these same children since the beginning of the Bt-20 study [45, 110, 117, 134].

The same semi-quantitative food frequency questionnaire was used at each nutrition interception of the Bt-20 study in 1995; 1997; 1999 and 2000 and 2003 for consistency. It was designed to obtain a picture of the children's diet as a whole. The food items listed in the questionnaire were based on many years of experience on the dietary intake of South African children [45]. Standard portions were used based on the Research Institute for Nutrition Diseases (RIND) Food Quantities Manual composition Tables manual [135]. For certain food items (bread, oil, ice-cream, margarine/butter) actual amount used were asked.

2.4.1 Food Frequency Questionnaire

The food frequency questionnaire used was divided into three sections: The introductory part, section A and section B. The introductory section included general information about the child's name and surname, Birth-to-Twenty-number, date of birth,

age(year and month), sex, ethnic group, survey venue and survey date.

Section A comprised food items listed under eight main food groups which is schematically shown in Fig. 2.3.

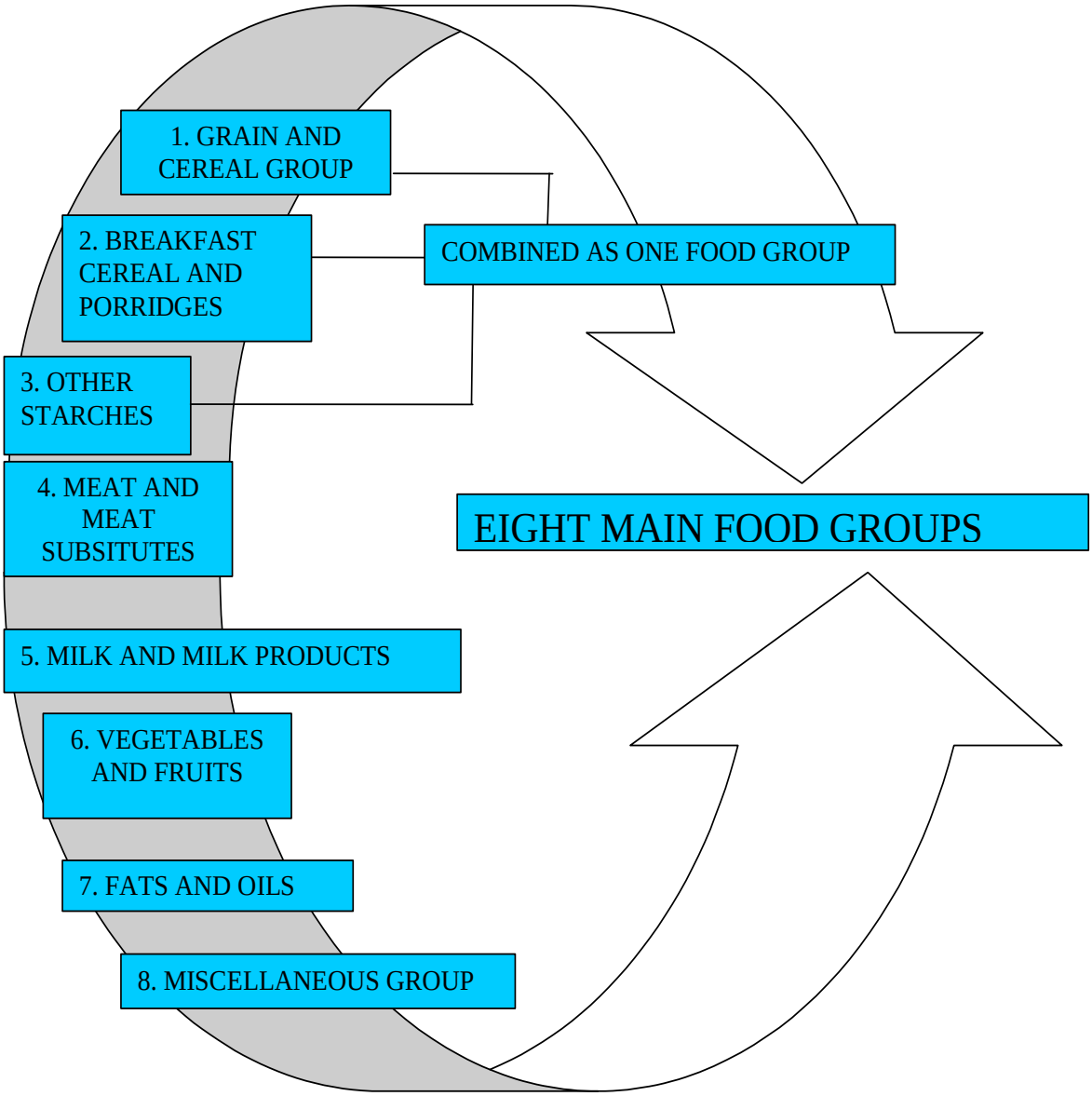


Fig. 2.3: Schematic diagram of the eight main food groups in the food frequency questionnaire.

Frequency of food intake was indicated weekly; (7, 6, 5, 4, 3, 2 or 1 per week), monthly and rarely. To identify ways to ease the task of completing the food frequency questionnaire while enhancing accuracy of responses, additional questions were asked:

- Types of fruits and vegetables consumed during the past week: raw and/or cooked and preparation method used.
- Number of slices of bread, type of bread: white/brown/whole-wheat bread.
- Amount of butter/margarine used in teaspoons; in food preparation, on bread and added to vegetables consumed.
- Amount of milk consumed, measured in cups on cereals/as a beverage/ on porridges and in tea/coffee.
- Foods added to other foods: the addition of sugar to tea/coffee, milk.

A 24-hour recall questionnaire formed an independent section of the questionnaire (section B) where the number of portions, 0-10, of the following food groups namely:

- milk;
- meat/fish/chicken/cheese/eggs/nuts
- legumes
- fruits
- vegetables
- potatoes
- bread/cereal/porridge/rice/pasta/maize/meal/samp/mielierice

- oil/butter /margarine/cream/non-diary-creamers and salad dressing consumed over a 24-hour period were indicated.

These additional questions were used to cross-check with the food frequency questionnaire to minimize over-estimation, typical of the food frequency questionnaire [45]. For example the number of portions of meat and meat substitutes consumed in the preceding 24-hour should have corresponded with the frequency categories circled in the food frequency section [45]. For convenience and to simplify presentation similar food items such as grain/cereal group and breakfast/cereal/porridges and other starches were combined making the food groups presented in this thesis to be six. The food frequency questionnaire used in this study is in appendix A

2.5 Interviews

2.5.1 The Interviewers - 1995, 1997, 1999, and 2000 interception

Collection of the data started in June for each interception. The process of training dietary interviewers for the collection of nutritional data involved three phases. The first phase was choosing people who understood most of the official South African languages and attendance of a training session two days before the commencement of the interview.

The second phase was the training of the five selected interviewers by two staff members of the MRC/WITS Dental Research Institute. This training process involved interviewing techniques, familiarizing themselves with the format and foods listed in the questionnaire.

The third phase was the practice sessions between themselves and on patients in the Dental Hospital. If these sessions did not meet levels of accuracy and specificity, the practices were repeated [45].

2.5.2 The interviewers - 2003 nutrition interception

The same five trained interviewers conducted the field work at the 2003 interception. The interviewers were multilingual and able to communicate with the subjects in their mother tongue. In addition to the 5 interviewers the candidate and 4 other staff members of the mobile team at Chris Hani Baragwanath Hospital were trained to interview the subjects/parents or guardians. All these interviewers were trained by the same staff member of the Dental Research Institute. This too allowed for consistency.

The mobile team were selected because of their multilingualism and their knowledge of the community; they are residents of the black township around which they travel and visit families. The same interviewers were involved in the multiple waves of data collection. Over the years, they tended to interview in the same sections of the metropolitan area and consequently became well-known to the mothers, the children, and their families [136]. Periodically, the candidate traveled with the mobile team to participate in data collection and to supervise and maintain quality control.

2.5.3 The interview locations - 1995, 1997, 1999 and 2000 interceptions

The major interview location in 1995 was at the Chris Hani Baragwanath Hospital and other clinics like Noordgesig, Bosmont, Riverlea, Berea, Parkhurst, Jeppe and Rosettenville, Crosby, Eldorado Park, Kliptown, Mayfair, Lenasia and Westbury. Data were

collected in person by the 5 multi-lingual interviewers. Parents/guardians were asked to indicate how frequently each listed food item in the questionnaire was consumed. The subsequent primary site for nutrition interception interviews (1997; 1999 and 2000) was only at Chris Hani Baragwanath Hospital. Either the children themselves (mostly 9 and 10 years old) and/or the parents were interviewed.

2.5.4 The interview locations - 2003 nutrition interception

The interview process for the year 2003 nutrition interception took place in two places:

1. Birth-to-Twenty, Department of Pediatrics, University of the Witwatersrand.

2. Home visits in the Johannesburg/Soweto metropolis by the mobile team.

Over a period of nine months (from August 2003 to April 2004), the five trained interviewers asked the participants [n=143] how often the food items listed were consumed and the interviewer just circled the appropriate number in the food frequency questionnaire. In addition, individual interviews with the children who did not visit the University were conducted by the mobile team members. This encouraged the subjects to give accurate verbal responses of what they had eaten and the interviewers just had to circle how often the individual food items were consumed. The interviews took 15-20 minutes and were held privately without parents/guardian interference.

2.6 Data Coding

The same five interviewers coded the data for 1995; 1997; 1999 and 2000 and the candidate coded the data for 2003. Both the interviewers and the candidate were trained by the same person (Dr. J. M. Mackeown) in coding techniques. The same coding

sheet was used for all five interceptions. Hence there was consistency throughout the study. The data collected from the Food Frequency Questionnaire were coded onto computer coding sheets (Appendix C) using the MRC Food Composition Tables and Codes [137]. Either recorded or standard portions sizes were used based on the use of the National Research Institute for Nutritional Diseases (NRIND) Food Quantities Manual.

Each computer data sheet consisted of 8 columns and 10 rows. The first 6 blocks of the first card indicated the study year (first 2 block), followed by the individual's ID number (4 blocks) and the last 2 blocks the card number, starting with 05 for dietary intake. In the second row of the first card the first 4 blocks indicated the individual's decimal age, followed by the sex code (male=1, female=2), dietary method (04 for food frequency questionnaire), and day (00). The other 8 rows of the first card consisted of food items, the first 4 blocks of each row being the food code, followed by the amount consumed in grammes in the next 4 blocks. This was estimated by standard portion sizes and household measures. The last 2 blocks recorded the weekly frequency of the food item.

The top row of each subsequent card for the same individual had the same year and the same ID number as card 1, with the last 2 blocks of the first row being the consecutive card number-06. The next 9 rows comprised the food item codes and amounts and frequency as in card 1. This continued for each consecutive card until all the food items mentioned in the questionnaire had been entered onto the coding sheet [45]. The computer coding sheet is shown in appendix B

2.7 Computer methodology

The completed coded data sheets were sent to a data capturing service (Omnidata, Rissik Street, Johannesburg) to be put on disk. The data set involved extensive cleaning, which took a considerable amount of time, not only with correcting each individual data set but matching the subjects for each interception. Throughout the study each subject kept their same ID number. Only the first two digits, being the year, 95, 97, 99,2000, 2003 would change.

2.7.1 Statistical analysis

SAS was used for the statistical analysis [138]. Programmes specifically written by the University of the Witswatersrand Computer and Networking Services were used to systematically rearrange the raw data, merge and extract the true longitudinal group of 143 children for each interception by ID number. The pictorial presentation of the statistical analysis system used for this present thesis is shown in figure 2.4.

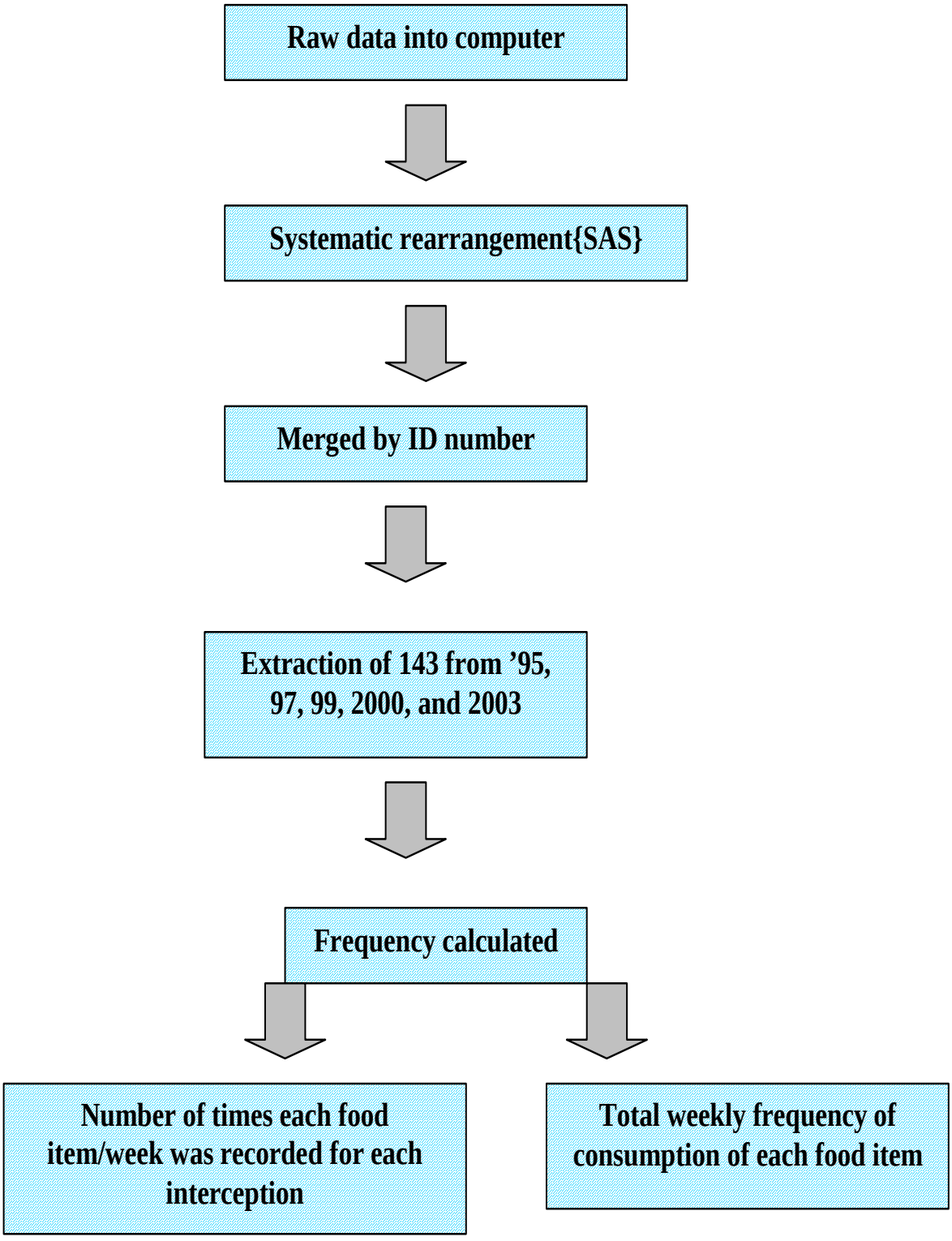


Fig. 2.4: Pictorial presentation of the statistical analysis of the data.

Frequencies were calculated for:

1. The number of times each food item was recorded per week, firstly for all five interceptions combined and secondly for each interception separately. The total number times each food item was recorded for all five interceptions combined was divided by the total number of times all food items at all five interceptions combined were recorded and expressed as a percentage (chapter 3).

   The total number of times each food item was recorded at each interception separately was divided by the total number of children in the group [n=143] and expressed as a percentage (chapter 4).

2. The total weekly frequency of consumption for each food item. The mean weekly frequency of consumption for each food item was calculated for all the children in the group [n=143] for each interception separately (total weekly frequency of consumption of each food item/total number of children [n=143] and then only for those in the group consuming the food items (total weekly frequency of consumption of each food item/number of times each food item was recorded for each interception (chapter 5).

The food items were ranked in descending order according to:

- their percentage contribution of the total number of times all food items at all five interceptions combined were recorded (chapter 3)
- the average number of times recorded for all five interceptions combined (chapter 3) and

- the mean weekly frequency of consumption for all five interceptions combined (chapters 4 and 5).

The ranked food items were then arranged within the 8 food groups listed in the questionnaire (chapters 3, 4, 5). Forty-one food items made up 1% or more of the total number of times all food items were recorded for all five interceptions combined. This was used as a cut-off point as all the other food items were recorded too infrequently to include. For this reason only these forty-one items will be discussed in chapter 3, 4 and 5 of this thesis.

The results are presented in chapter 3, 4 and 5, each chapter with an expanded statistical methodology appropriate for each section. Chapter 3 gives the global picture of the total number of food items recorded by the longitudinal group of 143 children over 5 interceptions. The percentage of children in this group consuming the individual food items is presented in chapter 4 and chapter 5 presents the weekly frequency of consumption of the individual food items for all 143 children as well as for only those consuming the items. Discussion of the results of the present study and studies conducted in South Africa and from both developing and developed countries are discussed in chapter 6. Final conclusions and recommendations are presented in chapter 7.

3. RESULTS: THE TOTAL NUMBER OF FOOD ITEMS RECORDED

This chapter discusses the results of the total number of food items recorded over the 5 interceptions, as mentioned previously, and presents a global perspective of the variety and consumption of all the food items.

3.1 Total number of food items recorded (1995-2003) and percentage contribution for all children [n=143]

3.1.1 Methodology

The percentage contribution of food items for each year was calculated as:

$$\frac{\mathrm{X}}{\mathrm{Y}} \times 100$$

where:

X =Total numbers of food items recorded for '95; '97; '99; '00 and '03

Y = Total number of food items recorded for '95 + '97 + '99 + '00 + '03 [546]

3.1.2 Results

The food items consumed by this longitudinal group of urban black South African children during the eight-year period of nutrition interception varied widely. A total of

546 different food items were recorded over the five interceptions. The highest number of food items recorded was 124 in 1999 and 123 in 2003 both being 22.7% and 22.5% of the total number of food items recorded when the children were nine and thirteen years old, respectively. In comparison the lowest number of food items were recorded

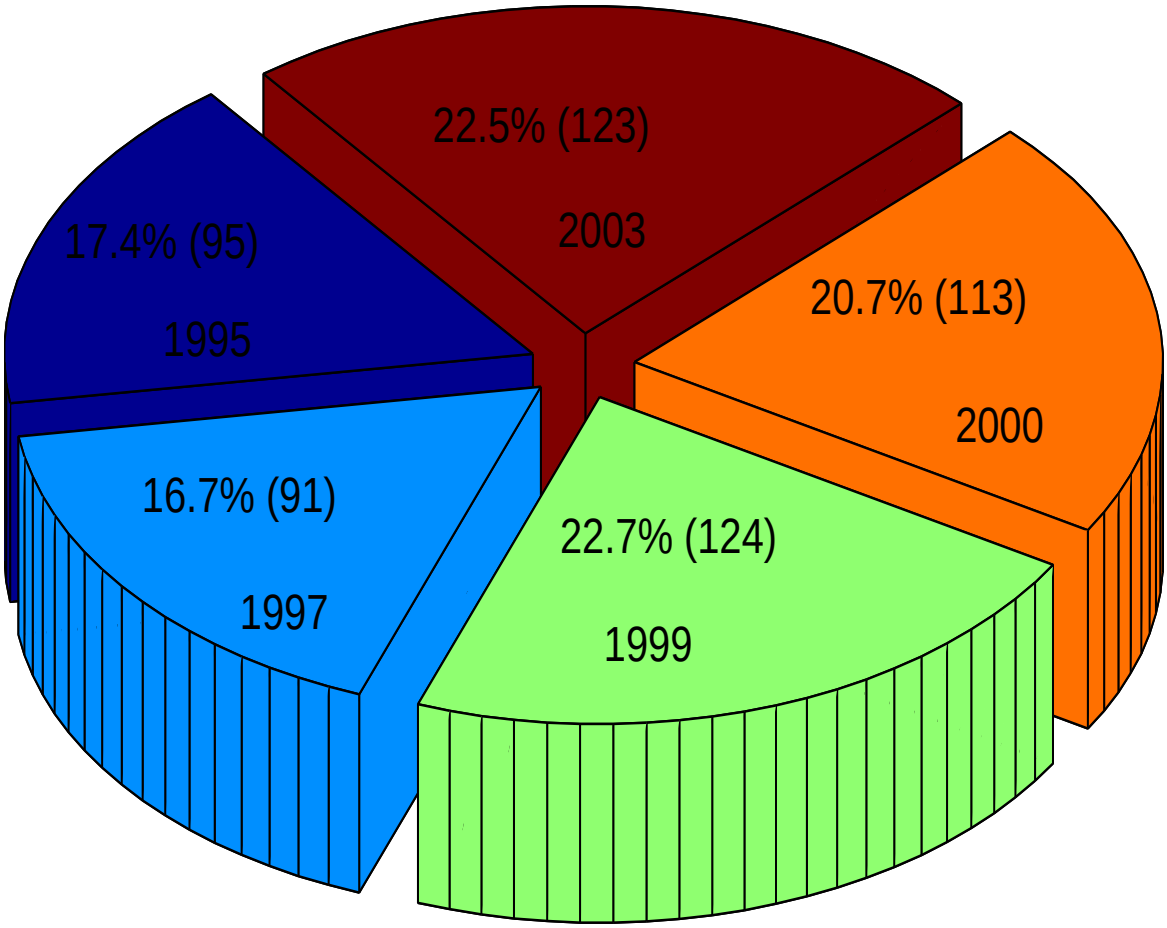


Fig. 3.1: Total number of food items recorded at each interception and percentage contribution of the total recordings (1995-2003) [n=546].

in 1995 [n=95] and 1997 [n=91] being 17.4% and 16.6%, when the children were five and seven years old respectively and lastly, the number of food items recorded in 2000 [n=113] contributed 21% of the total number of food items recorded (Fig. 3.1).

3.2 Number of recordings for each individual food item (1995-2003) and percentage contribution

3.2.1 Methodology

The percentage contribution of each individual food item for all 5 interceptions was calculated thus:

$$\frac{\mathrm{X}}{\mathrm{Y}} \times 100$$

where:

X=Total number of times each individual food item was recorded for '95; + '97; + '99; '00 + '03

Y=Total number of recordings for all food items recorded for '95 + '97 + '99 + '00 + '03 [23840]

The individual food items were then ranked in descending order according to these percentages.

3.2.2 Results

The 546 different food items were recorded 23840 times for all 5 interceptions combined. Forty-one food items contributed 1% or more to the total number of recordings for the five interceptions (Table 3.1). Of these, the top 10 food items contributed between 2.5% to 3% of the overall total number of recordings namely: rice 2.87%, stiff maize-meal porridge 2.84%, chicken 2.82%, sugar 2.76%, sweets 2.72%, tea 2.71%, eggs 2.62%, full cream milk 2.58%, carbonated beverages 2.52 and oil 2.51%. Twenty-three food items contributed 1.5-2.5% and lastly eight food items were between 1-1.5%. Rice was the

Tab. 3.1: The top 41 food items ranked in descending order according to the total number of times each food items was recorded and their percentage contribution for all the 5 interceptions combined [n=23840].

No.	**Food item**	**Total number of times recorded for all 5 interceptions combined**	**%**
1	Rice	684	*2.87*
2	Stiff maize-meal porridge	676	*2.84*
3	Chicken	672	*2.82*
4	Sugar	657	*2.76*
5	Sweets	649	*2.72*
6	Tea	646	*2.71*
7	Eggs	624	*2.62*
8	Full cream milk	616	*2.58*
9	Carbonated beverages	600	*2.52*
10	Oil	599	*2.51*
11	Brown Bread	559	2.34
12	Beef stew	552	2.32
13	Peanut butter	540	2.27
14	Biscuits	537	2.25
15	Crisps	505	2.12
16	Apple	497	2.08
17	Jam	496	2.08
18	Mashed potato	489	2.05
19	Cabbage	472	1.98
20	Fried fish	468	1.96
21	Salad dressing	462	1.94
22	Popcorn plain	457	1.92
23	Cheese	456	1.91
24	Banana	456	1.91
25	Polony	448	1.88
26	Chocolate	444	1.86
27	Orange	442	1.85
28	Baked beans	425	1.78
29	Soft maize-meal porridge	413	1.73
30	Jelly	386	1.62
31	Coffee	380	1.59
32	Custard	367	1.54
33	Butter	360	1.51
34	Pumpkin	353	1.48
35	Ice cream	344	1.44
36	Samp and beans	309	1.29
37	Yoghurt	306	1.28
38	Margarine	285	1.19
39	Mixed vegetables	266	1.11
40	Non-dairy creamer	241	1.01
41	Liquid fruit juice/ceres	239	1.00

top food item, being recorded 684 times over the 5 interceptions and contributed just below 3% of the total number of recordings for all food items for all interceptions. This was followed by stiff maize-meal porridge, recorded 676 times and contributing 2.84% and the third top food item was chicken, recorded 672 times and contributing 2.82% of the total recordings for all food items for all interceptions. Interestingly, among the top ten food item recorded, the highest number of food items (4) were from the miscellaneous group namely: sugar (657 times), sweets (649 times), tea (646 times) and carbonated beverages (600 times), respectively. The food items that featured low down on the ranked list (Table 3.1) were mixed vegetables (266 times), non-dairy creamer (241 times) and fruit juice (239 times), being 1.11%, 1.01% and 1.0% of the total number of recordings, respectively.

3.3 Number of recordings for each individual food item for each interception

3.3.1 Methodology

The number of times each individual food item was recorded for each interception separately was expressed as a mean for the 5 interceptions and the standard deviation (SD) was calculated. These items are shown in Table 3.2 ranked in descending order according to the mean number of recordings. The forty-one food items from Table 3.2 were then subdivided and ranked in descending order within the food groups according to the semi-quantitative food frequency questionnaire used. In addition, comparison of individual food items between all the five interceptions were made and the trend of the urban black children's dietary patterns are discussed in each figure (3.3 to 3.8). The symbols used in Figs. 3.3 to 3.8 are presented in Fig. 3.2.

Tab. 3.2: The top 41 food items ranked in descending order according to the mean number of times each food items was recorded at all the interceptions and standard deviation (SD).

No.	**Food item**	**YEAR**					**Mean**	**SD**
		1995	**1997**	**1999**	**2000**	**2003**		
1	Rice	140	138	138	139	129	136.8	4.4
2	Stiff maize-meal porridge	135	136	135	141	129	135.2	4.3
3	Chicken	132	130	136	140	134	134.4	3.9
4	Sugar	138	142	108	130	139	131	13.8
5	Sweets	132	138	132	120	127	129.8	6.6
6	Tea	135	129	126	130	126	129.2	3.7
7	Eggs	125	131	124	129	115	124.8	6.2
8	Full cream milk	133	128	129	127	99	123.2	13.7
9	Carbonated beverages	121	127	117	121	114	120	4.9
10	Oil	139	137	133	118	72	119.4	27.9
11	Brown Bread	113	107	113	118	108	111.8	4.4
12	Beef stew	135	134	59	102	122	110.4	31.7
13	Peanut butter	129	111	113	116	71	108	21.8
14	Biscuits	114	132	95	110	86	107.4	17.8
16	Samp and beans	133	131	70	70	101	101	31.0
15	Crisps	133	131	70	70	101	101	31.0
17	Apple	122	117	101	77	80	99.4	20.6
18	Jam	90	115	102	111	78	99.2	15.3
19	Mashed potato	116	118	117	101	37	97.8	34.7
20	Cabbage	129	107	104	102	30	94.4	37.6
21	Fried fish	111	108	97	81	71	93.6	17.3
22	Salad dressing	109	83	94	86	90	92.4	10.2
23	Popcorn plain	102	64	115	121	55	91.4	30.1
24	Cheese	85	77	101	101	92	91.2	10.4
25	Banana	100	107	91	86	72	91.2	13.4
26	Polony	0	125	111	115	97	89.6	51.1
27	Chocolate	95	117	81	67	84	88.8	18.7
28	Orange	116	120	80	82	44	88.4	30.1
29	Baked beans	90	105	87	75	68	86.8	14.3
30	Soft maize-meal porridge	125	60	81	77	70	82.6	25.0
31	Jelly	121	98	65	44	53	76.2	32.3
32	Coffee	70	97	58	73	82	76	14.5
33	Custard	92	92	69	53	61	73.4	17.9
34	Butter	138	132	43	0	47	72	60.4
35	Pumpkin	104	92	75	64	18	70.6	33.2
36	Ice cream	74	78	45	48	99	68.8	22.5
37	Low-fat-yoghurt	82	67	37	53	67	61.2	16.9
38	Margarine	1	0	80	129	75	57	55.7
39	Mixed vegetables	74	67	51	51	23	53.2	19.7
40	Non-dairy creamer	70	74	42	55	0	48.2	29.8
41	Liquid fruit juice/ceres	16	26	78	20	99	47.8	38.1

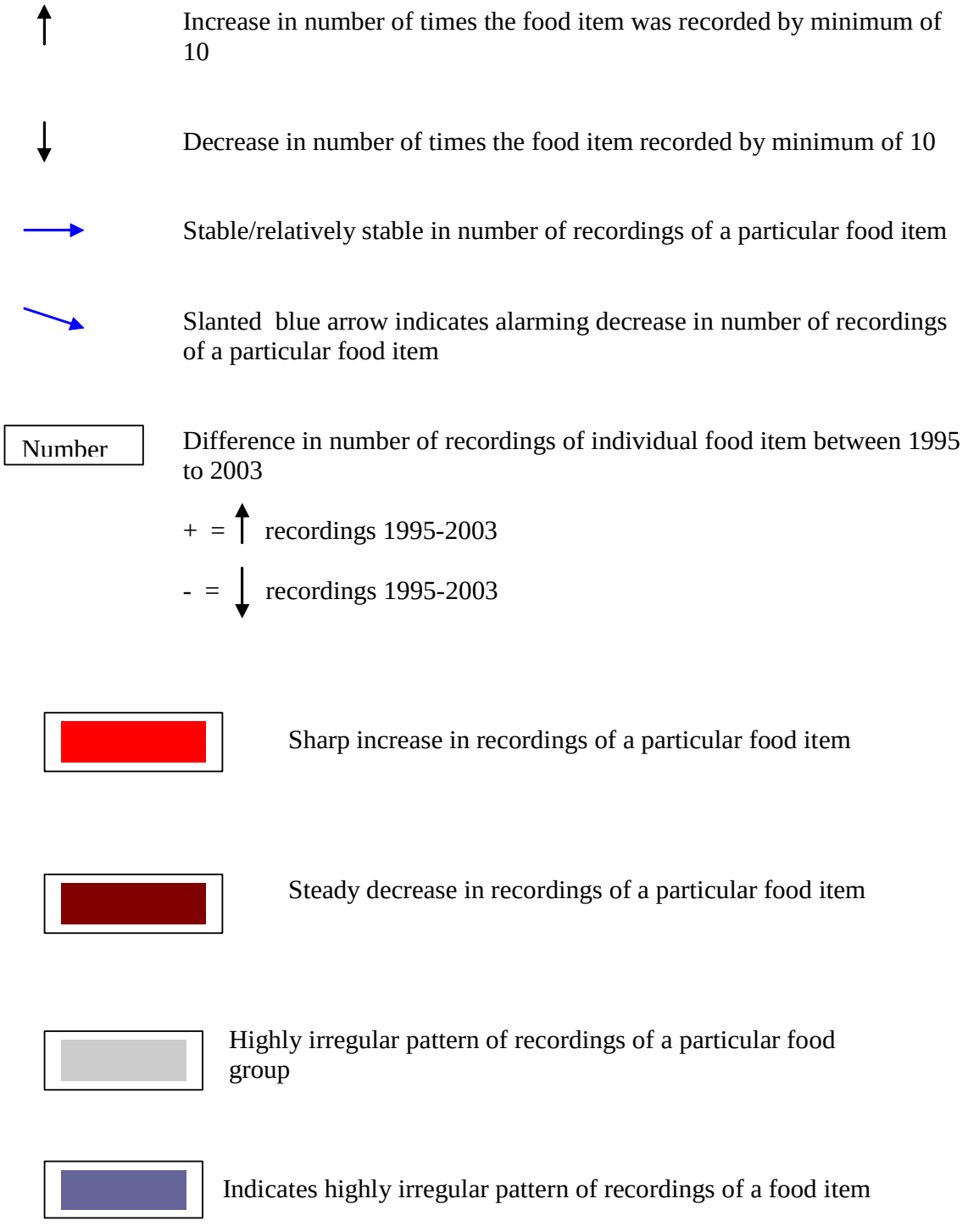


Fig. 3.2: Keynote used in Figs. 3.3 – 3.8

No	Food item	YEAR					Comments
		1995	1997	1999	2000	2003	
1	Rice	140	138	138	139	129 -11	Stability in the number of recordings except a slight decrease in 2003
2	Stiff maize-meal porridge	135	136	135	141	129 -6	Slight decrease in the number of recordings in 2003
3	Brown bread	113	107	113	118	108 -5	Highest number of recordings was in 2000, while similar number of recordings in 1995; 1999; 1997 and 2003, although with a slight decrease
4	Soft maize-meal porridge	125	60	81	77	70 -55	Very sharp decrease in the number of recordings in 1997, the number of recordings decreased from 1995 to 2003
5	Samp and beans	133	131	**70**	**70**	101 -32	Number of recordings was similar in 1995 and 1997, decrease in 1999, remained stable to 2000 and eventually increased minimally in 2003 but less than the number of recordings in 1995

Fig. 3.3: Comparison of the number of recordings for the grain/cereal group, breakfast cereal/porridges and other starches over the 5 interceptions.

3.3.2 Results

Fig. 3.3 shows the comparison of the number of recordings for the grain/cereal group, breakfast cereal/porridges and other starches. Both soft maize-meal porridge and samp and beans showed sharp decrease in 1999 and 2000, respectively but then increased again. All the 5 food items in this group showed an overall decrease over the interceptions in the number of recordings. The highest decrease being for soft maize-meal porridge (-55). Generally, there were stabilities in recordings of rice, stiff maize-meal porridge and brown bread over the 5 interceptions (Fig. 3.3).

In the category of meat and meat substitutes (Fig. 3.4), recordings for chicken, eggs, beef stew, peanut butter, cheese, polony and baked beans were relatively stable, but recordings for fried fish decreased steadily from 1995 to 2003. There was an overall increase in the number of recordings from 1995 to 2003 for chicken (n=+2), cheese (n=+7) and polony (n=+97), but an overall decrease for the other meat and meat substitutes.

However, recordings for fruit and vegetables such as cabbage, mashed potato, orange, pumpkin, mixed vegetables, apple, and banana all decreased sharply between 1995 to 2003 (Fig. 3.5). Fruit juice showed a highly irregular pattern of recordings during the five interceptions with a significant increase in 2003, (16 recordings in 1995; 90 recordings in 2003) with an overall increase of 74 recordings from 1995 to 2003.

No	Food item	YEAR					Comments
		1995	1997	1999	2000	2003	
1	Chicken	132	130	136	140	134 +2	Stability in the number of recordings over the years with a minimal increase in 2000
2	Eggs	125	131	124	129	115 -10	The number of recordings were relatively stable except a decrease in 2003
3	Beef stew	135	134	59	102	122 -13	Number of recordings was similar in 1995 and 1997, but decreased sharply in 1999 and increased again in 2000 and eventually increased minimally in 2003 but less than the number of recordings in 1995
4	Peanut butter	129	111	113	116	71 -58	Drastic decrease in the number of recordings from 1995 to 2003
5	Fried fish	111	108	97	81	71 -40	Steady decrease in the number of recordings from 1995 to 2003
6	Cheese	85	77	101	101	92 + 7	There were similar number of recordings in 1999 and 2000 but over the years the number of recordings increased from 1995 to 2003
7	Polony	0	125	111	115	97 +97	The number of recordings drastically increased from 0 in 1995 to 125 in 1997. Stable number of recordings in 1999 and 2000. From 1995 to 2003 number of recordings increased
8	Baked beans	90	105	87	75	68 -22	Steady decrease in the number of recordings from 1995 to 2003 with exception in 1997 which had the highest number of recordings

Fig. 3.4: Comparison of the number of recordings for meat and meat substitutes over the five interceptions.

No	Food item	YEAR				
		1995	1997	1999	2000	2003
1	Cabbage	129	107	194	102	30
						-99
2	Mashed potatoes	116	118	117	101	37
						-79
3	Fruit juice	16	26	78	20	90
						+74
4	Orange	116	120	80	82	44
						-72
5	Pumpkin	104	92	75	64	18
						-56
6	Mixed vegetables	74	67	51	51	23
						-51
7	Apple	122	117	101	77	80
						-42
8	Banana	100	107	91	86	72
						-28

Comments
Through out the eight-year of nutrition interception, there had been alarming, sharp and steady decrease in the number of recordings for fruits and vegetables. Only fruit juice showed an irregular pattern in the number of recordings and was the only food item with positive number of recordings in 2003 (90), from a very low number of recordings (16) in 1995

Fig. 3.5: Comparison of the number of recordings for fruits and vegetables over the five interceptions.

No	Food item	YEAR					Comments
		1995	1997	1999	2000	2003	
1	Oil	139	137	133	118	72 -67	Sharp decrease in the number of recordings in 2003 nutrition interception
2	Salad dressing	102	64	115	121	55 -47	Irregular pattern in the number of recordings, with a huge decrease in 1997 and 2003,
3	Butter	138	132	43	0	47 -91	Almost similar number of recordings in the first two interceptions but decreased sharply in 1999 and drastically decreased again in 2000 to 0 and eventually increased in 2003 but less than the initial number of recordings in 1995
4	Ice-cream	74	78	45	48	99 +25	The highest number of recordings for ice-cream was in 2003, similar and stable trend in the number of recordings in 1995, 1997; but decreased in 1999, 2000.
5	Margarine	1	0	80	129	75 +74	Highly irregular pattern in the number of recordings for margarine
6	Non-dairy creamer	70	74	42	55	0 -70	The number of recordings were relatively stable until 2003 which drastically decrease to zero.
Total	Butter+ Margarine	139	132	123	129	122	This is probably the real picture

Fig. 3.6: Comparison of the number of recordings fats and oils over the five interceptions.

No	Food item	YEAR					Comments
		1995	1997	1999	2000	2003	
1	Full cream milk	133	128	129	127	99	Decrease in the number of recordings in 2003 and the number of recordings from 1995-2000 were stable
2	Custard	92	92	69	53	61	The number of recordings decreased from 1995 to 2003 and the lowest number of recordings was in 2000
3	Low-fat yoghurt	82	67	37	53	67	Irregular pattern in the number of recordings. Similar and decreased number of recordings in 1997 and 2003 but less than the initial number of recordings in 1995

Fig. 3.7: Comparison of the number of recordings for milk and milk products over the five interceptions.

No	Food item	YEAR					Comments
		1995	1997	1999	2000	2003	
1	Sugar	138	142	108	130	139	The number of recordings were stable over the interceptions, only decreased in 1999
						+1	
2	Sweets	132	138	132	120	127	The number of recordings were stable, except slight decrease in 2000 and 2003
						-5	
3	Carbonated beverages	121	127	117	121	114	Similar number of recordings in 1995 and 200 but the lowest number of recordings was in 2003
						-7	
4	Biscuits	114	132	95	110	86	The number of recordings were slightly irregular and decreased from 1995 to 2003
						-28	
5	Jam	90	115	102	111	78	Stable and increased number of recordings from 1997 to 2000, but decreased from 1995 to 2003
						-12	
6	Chocolate	95	117	81	67	84	The lowest number of recordings was in 2000 but from 1995 to 2003 there was a slight decrease in the number of recordings and the highest was in 1997
						-11	
7	Jelly	121	98	65	44	53	From 1995 to 2003, there had been drastic decrease in the number of recordings with irregular pattern in three interceptions (1997,1999 and 2000)
						-68	
8	Tea	135	129	126	130	126	The number of recordings were stable
						-9	
9	Coffee	70	97	58	73	82	The number of recordings increased from 1995 to 2003 but the highest number of recordings was in 1997
						+12	
10	Crisps	133	131	70	70	101	Almost similar pattern in the number of recordings in 1995 and 1997 but decreased in 1999 and remained the same in 2000. The number of recordings increased again in 2003 but less than the initial number of recordings in 1995
						-32	
11	Popcorn plain	102	64	115	121	55	Almost the same pattern in the number of recordings for three interceptions, 1995,1999 and 2000, but the number of recordings decreased in 1997 and was the lowest number in 2003
						-47	

Fig. 3.8: Comparison of the number of recordings for miscellaneous foods over the five interventions.

In the first three interceptions 1995; 1997; 1999, recordings of cooking oil was relatively stable being recorded between 133 and 139 times but there was a gradual decrease in recordings in the year 2000 to 118 with a further decrease in 2003 to 72 times. Within the fats and oils food group, there were fluctuations in the consumption of salad dressing, butter and margarine and non-dairy creamers, whereas the intake of ice cream increased from 1995 (number of recordings=74) to 2003 (number of recordings=99) (Fig. 3.6)

The intake of full cream milk was stable till the year 2000 being recorded between 127 and 133 times but then decreased in 2003 to 99. The intake of custard and low-fat yoghurt showed irregular patterns of consumption over the eight years (Fig. 3.7).

With reference to the miscellaneous food items, these items were not ranked in descending order according to the number of recordings but they were grouped as follows: sugar containing foods, foods with low nutrients and fat. An important issue to note was that eleven out of the forty-one food items that contributed 1% or more of the total number of food items recorded, were from the miscellaneous group namely: sugar, sweets, tea, carbonated beverages, biscuits, crisps, jam, popcorn, chocolate, jelly and coffee (Fig. 3.8). Most of these items showed an overall decrease in the number of times recorded from 1995-2003 with the exception of sugar and coffee which increased over this time.

3.4 Discussion

3.4.1 Main findings

The total number of food items recorded was 546 over the five interceptions. These items were recorded 23840 times between 1995-2003. Of this, 41 items contributed 1% or more of the total number of recordings. Foods from the grain and cereal group generally showed a decrease in the number of times recorded over the 5 interceptions, as did the fruit and vegetables and milk and milk products. However, among the meat and meat substitutes chicken and cheese increased over this time as did margarine and ice-cream among the fats and oils. Among the miscellaneous group sugar, sweets, tea and carbonated beverages remained fairly stable over the 5 interceptions, but there was an increase in the number of recordings for crisps and chocolates from 2000 to 2003.

3.5 Conclusions

There has been a change in consumption of foods reported by this longitudinal group of urban black children, living in the Johannesburg/Soweto area of the Gauteng Province of South Africa, but there is still a limited number and variety of items consumed - 41 items contributing over 1% of the total number of items recorded over 8 years [n=546]. Furthermore, black South Africans are experiencing rapid socio-economic, political changes and most importantly are experiencing a nutrition transition [80, 139, 140]. Hence, the results of the present investigation can only be characterized to these children and cannot be compared with other South African children or those from other developed or developing countries.

Results of epidemiological studies from different parts of the world have proved that nutrition adequacy of a diet increases with a greater number of different foods [10, 39, 46, 47]. As stated by Maunder "it is important to ensure that the biodiversity of food sources is maintained and nutrient-dense foods are consumed" [11]. This will help to solve the problem of chronic under- and over-nutrition in developing countries and the diseases of affluence in developed countries [6, 9, 46, 47, 64, 27, 121]. In addition, the type of foods children consume changes as they grow from the age of 5 to 13. For example younger children consume more foods such as: milk + soft porridge, soft porridge, jelly and mashed potato. Eating habits may change as children enter the adolescent phase (10-13years), they probably consume less milk, more crisps and popcorn. With the age group in this study starting from age 5, it was probably unlikely that fast foods and urban African street foods were consumed. As these children enter adolescence, there would likely be higher and more frequent consumption of these foods,but this did not form part of the study.

South African Food Based Dietary Guidelines specifically emphasizes eating a variety of foods because generally many black African's dietary patterns are simple and monotonous, not varying from day to day or meal to meal [9, 11, 121]. Thus, their food intakes tend to be nutritionally inadequate, and this may put them at risk in relation to health.

Besides the Bt-20 Study, all the other South African studies have been cross-sectional. Longitudinal investigation, such as the present study, are the only accurate means of studying the nutrition transition with true change in dietary habits among the same individuals over time. The present study has done this, and strengthened the evidence

from the cross-sectional studies in South Africa that dietary habits have changed and the nutrition transition has changed the importance and type of food items consumed.

4. RESULTS: PERCENTAGE OF CHILDREN CONSUMING THE FOOD ITEMS

In contrast to Chapter 3 that dealt with the total number of food items recorded for each interception, this chapter deals with the percentage of children consuming each food item at each interception.

4.1 Methodology

The percentage of children consuming the food items was calculated as follows:

$$\frac{\mathrm{X}}{\mathrm{Y}} \times 100$$

where:

X = Number of times each individual food item was recorded for each interception.

Y = Total number of children [n=143].

The mean percentage of children consuming each food item for all 5 interceptions were calculated, and food items were ranked in descending order according to the mean percentage for all 5 interceptions and ranked further within the food groups according to semi-quantitative food frequency questionnaire used.

4.2 Results

Table 4.1 shows the forty-one food items, ranked in descending order according to the mean percentage of children consuming each food item for all the five interceptions. Only six food items namely: rice, stiff maize-meal porridge, chicken, sugar, sweets and tea of the top 41 food items were consumed by 90% or more of the children over the five interceptions. Fourteen food items were consumed by 75% or more of the children and 33% of these 41 items were consumed by 50% or more. All the top 41 food items were consumed by more than 33% of the children (Table 4.1).

Tab. 4.1: Percentage of children consuming each food ranked in descending order according to mean percentage for all interceptions and standard deviation (SD).

No.	**Food item**	**YEAR**					**Mean**	**SD**
		1995 [%]	**1997** [%]	**1999** [%]	**2000** [%]	**2003** [%]	[%]	
1	Rice	98	96	96	97	90	95.4	3.03
2	Stiff maize-meal porridge	94	95	94	98	90	94.2	3.13
3	Chicken	92	91	95	98	94	94	2.86
4	Sugar	96	99	75	91	97	91.6	9.73
5	Sweets	92	96	92	84	89	90.6	4.45
6	Tea	94	90	88	91	88	90.2	2.49
7	Eggs	89	92	87	91	80	87.8	4.76
8	Full cream milk	93	89	91	89	69	86.2	9.76
9	Carbonated beverages	85	89	82	85	80	84.2	3.42
10	Oil	97	96	93	82	50	83.6	19.70
11	Brown Bread	79	75	79	83	75	78.2	3.13
12	Beef stew	94	94	41	71	85	77	22.01
13	Peanut butter	90	78	79	81	49	75.4	11.97
14	Biscuits	80	92	66	77	60	75	11.16
15	Crisps	93	92	49	49	71	70.8	21.75
16	Apple	85	82	71	54	56	69.6	13.4
17	Jam	63	80	71	78	54	69.2	9.19
18	Mashed potato	81	82	82	71	26	68.4	18.26
19	Cabbage	90	75	73	71	21	66	20.19
20	Fried fish	78	75	68	57	50	65.6	10.36
21	Salad dressing	76	58	65	60	63	64.4	7.00
22	Popcorn plain	71	45	80	85	38	63.8	18.79
23	Cheese	71	71	64	59	54	63.8	6.51
24	Banana	70	75	64	60	50	63.8	8.11
25	Polony	0	87	78	80	68	62.6	35.59
26	Chocolate	66	82	57	47	59	62.2	12.93
27	Orange	81	84	56	57	31	61.8	18.30
28	Baked beans	63	73	61	52	47	59.2	9.02
29	Soft maize-meal porridge	87	42	57	54	48	57.6	17.04
30	Jelly	85	68	45	34	37	53.8	21.03
31	Coffee	49	68	40	51	57	53	10.26
32	Custard	64	64	48	37	43	51.2	11.93
33	Butter	96	92	31	33	0	50.4	37.48
34	Pumpkin	73	64	52	45	12	49.2	18.88
35	Ice cream	52	54	31	33	69	47.8	13.76
36	Samp and beans	64	48	36	36	31	43	12.53
37	Low-fat yoghurt	57	47	26	37	47	42.8	11.65
38	Margarine	0.7	0	56	90	52	39.7	38.60
39	Mixed vegetables	52	47	36	36	16	37.4	11.32
40	Non-dairy creamer	49	52	29	38	0	33.6	16.72
41	Liquid fruit juice/ceres	11	18	55	14	69	33.4	23.16

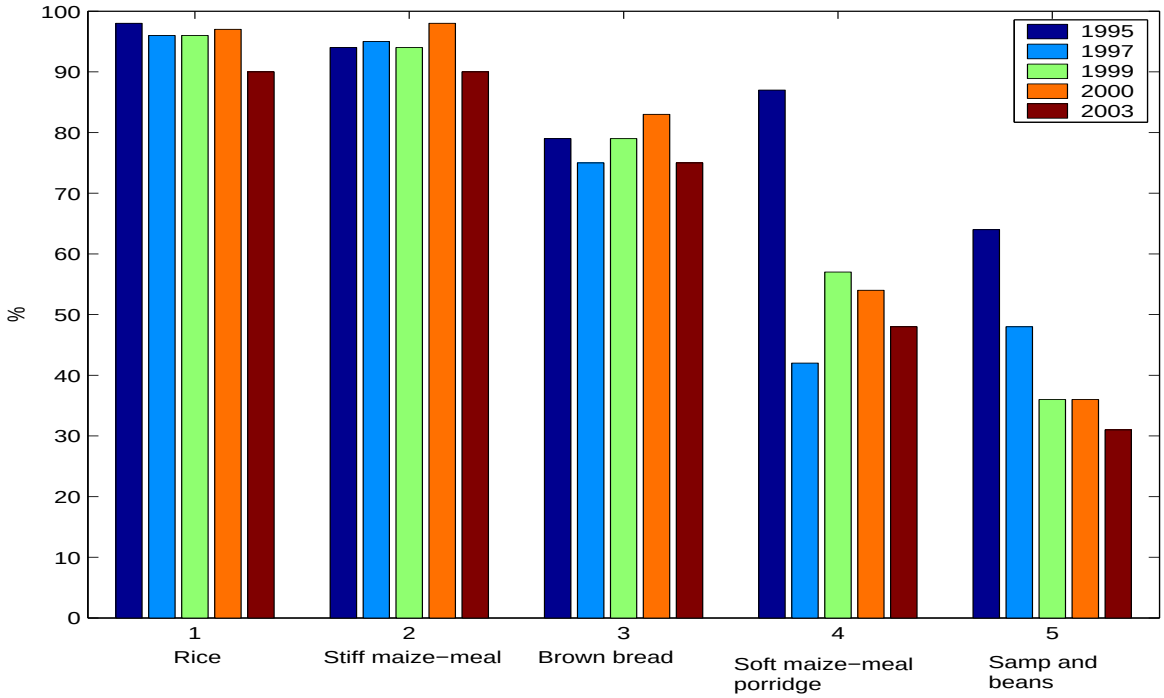


Fig. 4.1: Percentage of children consuming grain/cereal group,/breakfast cereal/porridges and other starches for each interception.

Rice and stiff maize-meal porridge were the most popular food items among grain/cereal group,/breakfast cereal/porridges and other starches (Fig. 4.1), being consumed by more than 90% of the children at all 5 interceptions. Brown bread was only consumed by 78% of the children over the 5 interceptions, the highest percentage consuming brown bread was in 2000 (83%). In contrast, soft maize-meal porridge, samp and beans were consumed by a lower percentaage at most interceptions.

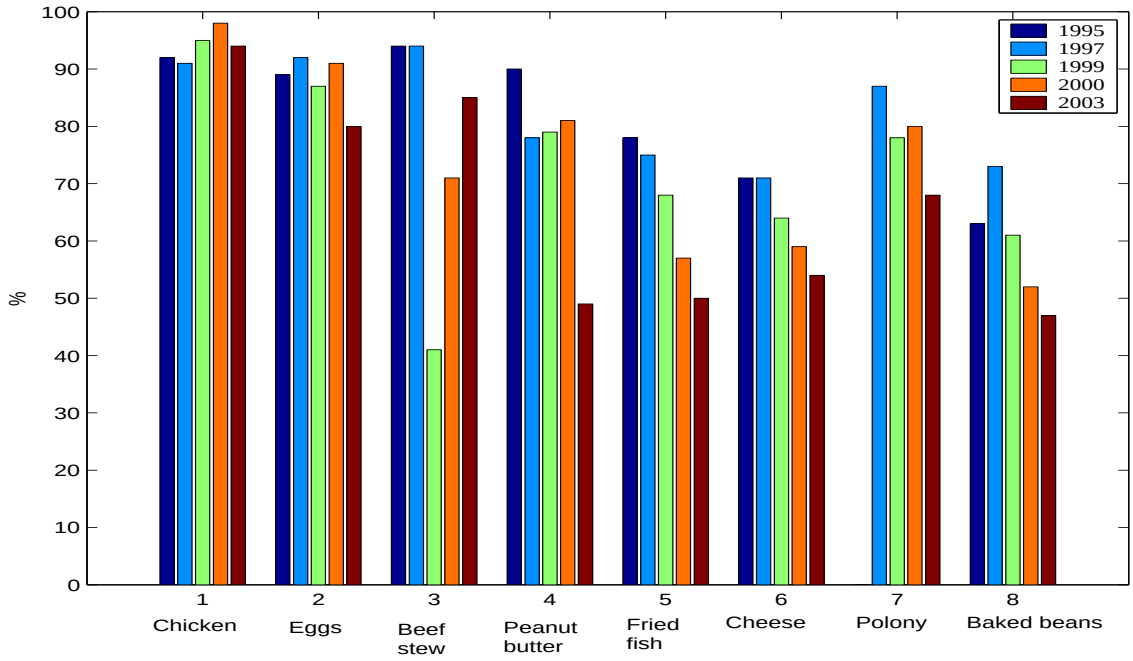


Fig. 4.2: Percentage of children consuming meat and meat substitutes for each interception.

Of the eight meat and meat substitutes (Fig.4.2), only chicken was consumed by more than 90% of the children at all 5 interceptions, followed by beef stew which was consumed by 94% of the children in 1995 and in 1997, but decreased over the other interceptions with only 41% consuming beef stew in 1999. Eggs were consumed by over 90% of the children in 1997 and 2000. In addition, there was a decrease in the percentage of children consuming peanut butter, fried fish, cheese and baked beans from 1995 to 2003, while the percentage of children consuming polony increased from 0% in 1995 to 68% in 2003, although it decreased from 1997 to 2003.

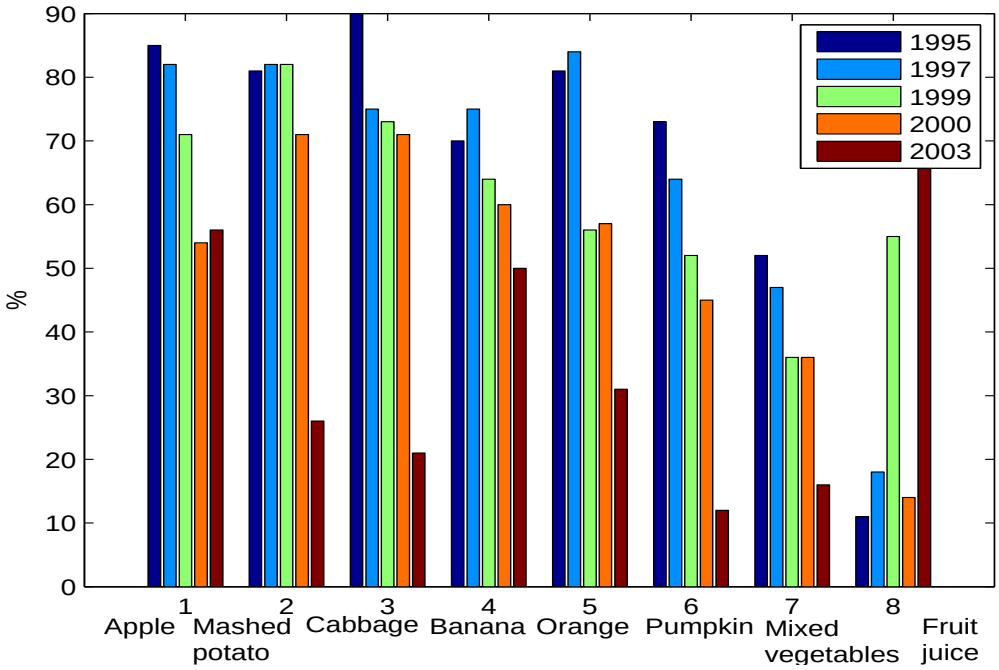


Fig. 4.3: Percentage of children consuming fruits and vegetables for each interception.

Mashed potato and cabbage among the vegetables (Fig. 4.3) were consumed by the highest percentage of children, the mean consumption over the 5 interceptions being 68% and 64%, respectively. Cabbage was consumed by 90% of the children in 1995 but decreased to only 21% in 2003. Mashed potato was consumed by 81% in 1995 but only 26% in 2003. Among the fruits, apples were consumed by the highest percentage (69.6%) followed by oranges (61.8%) over the 5 interceptions. Again the percentage of children consuming these fruits decreased from 1995-2003. Fruit juice was consumed by 11-18% (1995, 1997, 2000) but increased dramatically to 69% of the children consuming this item in 2003.

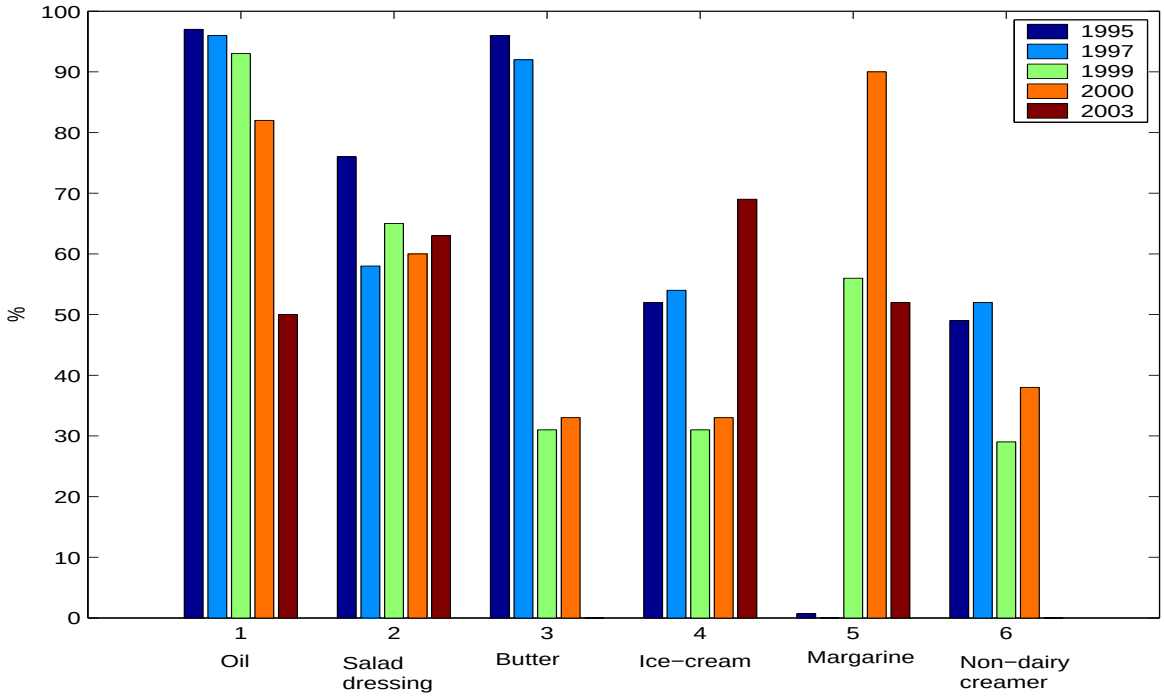


Fig. 4.4: Percentage of children consuming fats and oils for each interception.

In the group of fats and oils (Fig. 4.4), oil was consumed by 50-97% of the urban black South African children. Ninety-seven percent of the children consumed oil in 1995 decreasing to only 50% consuming oil in 2003. Butter was consumed by 96% and 92% of the children in 1995 and 1997, respectively. However, margarine seemed to replace oil and butter with 90% of the children consuming margarine in 2000. In the year 2003 interception, ice-cream proved popular among fats and oils being consumed by 69% of the children.

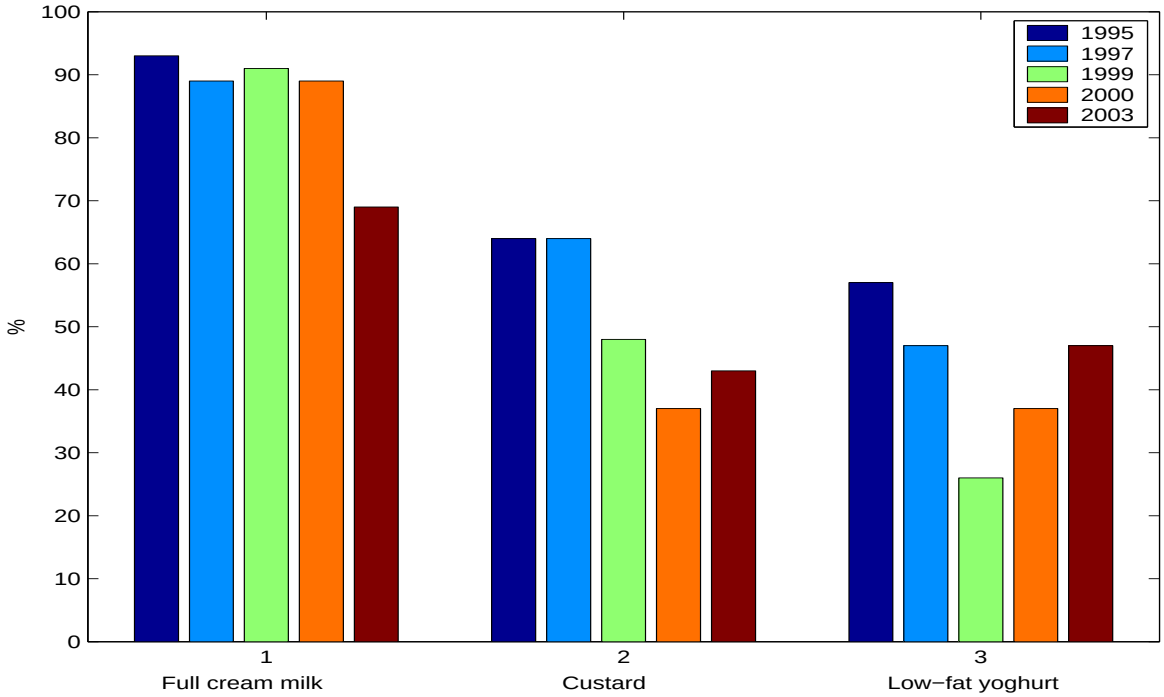


Fig. 4.5: Percentage of children consuming milk and milk products for each interception.

Milk and dairy products are the primary source of calcium, thus, Fig. 4.5 presents the principal source of milk and milk products among these children and these were full-cream milk, custard and low-fat yoghurt. More than 90% drank full-cream milk in 1995 and 1999 decreasing to only 69% in 2003, which was the lowest percentage for all the 5 interceptions. Sixty four percent of the children consumed custard in 1995 and 1997, while only 57% of the children consumed low fat yoghurt in 1995.

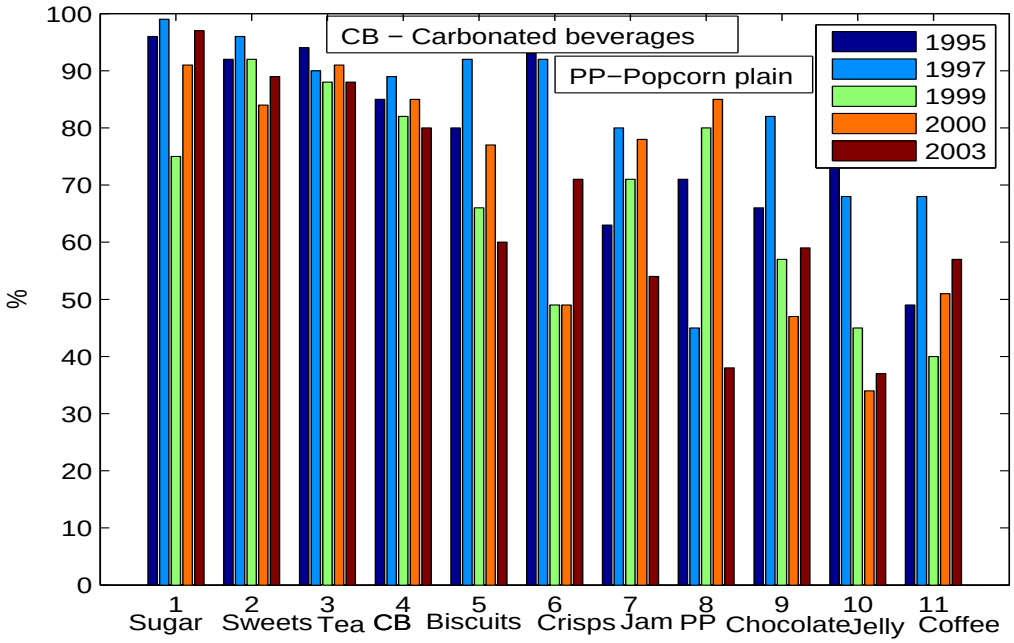


Fig. 4.6: Percentage of children consuming miscellaneous foods for each interception.

More than 90% of the children consumed sweets in 1995; 1997 and 1999 but decreased to 84% in 2000 and increased again to 89% in 2003. Sugar was consumed by more than 90% of the children for all interceptions except for 1999 when it was consumed by 75%. More than 90% of the childern consumed crisps in 1995 and 1997. This decreased to 49% in 1999 and 2000 but increased again in 2003 to 71%. Six of the 11 miscellaneous food items (sugar, sweets, crisps, chocolate, coffee and jelly) showed an increase in the percentage of children consuming them from 2000 to 2003 (Fig. 4.6).

4.3 Discussion

4.3.1 Main findings

It appeared from this study that 90% or more of the children consumed rice and stiff maize-meal porridge within the group of grain/cereal group/breakfast cereal/porridges and other starches. Brown bread was consumed by only 78% of the chidren over the 5 interceptions.

Chicken (94%) and eggs (87.8%) among the meat and meat sustitutes ranked higher on the list than beef stew (77%).

However, there was a general decrease in the percentage of children consuming fruits and vegetables over the 5 interceptions, particularly from 2000 to 2003 and the variety was limited. Sixty eight percent of the children consumed mashed potato among the vegetables, while 70% of the children consumed apples among the fruits. Within this food group fruit juice consumption increased dramatically in 2003 to 69% from 11-18% in the previous interceptions.

Eighty four percent of the urban black South African children consumed oil over the five interceptions. It is note worthy that from this food group only the consumption of ice-cream increased from 52% in 1995 to 69% in 2003.

Among the milk and milk products, milk was consumed by the highest percentage of the children. It was consumed by almost 90% of the children between 1995 and 2000 but dropped in 2003 to 69%.

Sugar, sweets and tea among the miscellaneous food items were consumed by the highest percentage (90-91%). Six of the eleven miscellaneous food items showed an increase in the percentage of children consuming these from 2000-2003.

4.4 Conclusions

The findings on the percentage of children consuming individual food items revealed that over 90% of this study population consumed both rice and stiff maize-meal porridge. It appears that to a certain extent, stiff maize-meal porridge is still a staple food among the black community in South Africa. Rice and stiff maize-meal porridge may be consumed regularly by most urban children because there was no significant difference in the percentage of children consuming them. Of great concern is the high percentage of children consuming miscellaneous food items over the 5 interceptions. Food items such as sugar, sweets, tea and carbonated beverages were consumed by 80% or more. Consumption of miscellaneous foods such as sugar, sweets, chocolate, crisps and others are linked to chronic diseases of lifestyle such as cardiovascular disease, diabetes mellitus, cancer and osteoporosis and in addition they are foods with low nutrient density [37]. In contrast, the percentage of children consuming vegetables and fruits decreased steadily during the period of investigation possibly leading to inadequate micronutrient intake.

5. RESULTS: MEAN WEEKLY FREQUENCY OF CONSUMPTION OF INDIVIDUAL FOOD ITEMS

This chapter discusses the mean frequency of consumption of individual food items for all the children and for only those consuming each food item.

5.1 Methodology

The mean weekly frequency of consumption of food items was calculated for:

5.1.1 All the 143 children

$$\frac{X}{Y}$$

where:

X = Total weekly frequency of consumption of each individual food item for each interception

Y = Total number of children [n=143].

5.1.2 Only those children consuming the food items

$$\frac{X}{Y}$$

where:

X = Total weekly frequency of consumption of each individual food item for each interception

Y = Total number of times each food item was recorded at each interception.

In each case the mean weekly frequency of consumption for the 5 interceptions was calculated and the food items ranked in descending order according to the mean frequency and then further ranked within the food groups.

5.2 Results

Table 5.1 shows the mean weekly frequency of consumption for the top forty-one food items, ranked in descending order according to the mean weekly frequency of consumption for all five interceptions. Only seven of the top 41 food items namely: sugar, tea, brown bread, full cream milk, soft maize-meal porridge, oil and sweets were consumed four times or more per/week for all 5 interceptions.

Of these seven food items, sugar was ranked the highest, the mean frequency of consumption being more than 6x/week. The remaining thirty-four food items were consumed between 0.5x/week to 3x/week over the 5 interceptions (Table 5.1).

Table 5.2 shows the weekly frequency of consumption of the top 41 food items for only those children consuming the food items, ranked in descending order according to the mean weekly frequency of intake for all 5 interceptions.

The top 13 food items were consumed on average 4 times per week or more for the 5 interceptions by only those children consuming the items.

The top food item was sugar being consumed everyday of the week for all interceptions

Tab. 5.1: Weekly frequency of consumption (mean and standard deviation) of individual food items for all the children [n=143], ranked in descending order according to the mean frequency of consumption for all 5 interceptions.

No.	**Food item**	**YEAR**					**Mean**	**SD**
		1995	**1997**	**1999**	**2000**	**2003**		
1	Sugar	6.8	6.9	5.1	6.3	6.8	6.4	.75
2	Tea	6.2	4.6	5.1	5.4	4.0	5.2	.83
3	Brown bread	5.5	5.0	5.0	5.3	4.5	5.1	.38
4	Full cream milk	6	6	5	4.4	3	4.9	1.25
5	Stiff maize-meal porridge	5.2	4.4	4.7	5.2	4.5	4.8	.38
6	Oil	3.3	6.6	5.3	4.2	2.8	4.4	1.54
7	Sweets	4.1	6.1	3.6	3.1	4.3	4.2	1.14
8	Butter	6.5	6.4	2.1	0	1.6	3.3	2.96
9	Peanut butter	5	3.6	3	2.6	2	3.2	1.14
10	Crisps	3.7	5	2.1	1.6	2.9	3.1	1.35
11	Eggs	3.9	2.6	3.4	2.9	2.4	3	.61
12	Carbonated beverages	3.3	3	2.6	2.2	3	2.8	.43
13	Chicken	2.3	2.2	3	2.9	2.8	2.6	.36
14	Biscuits	2.7	3.4	2.1	2.5	2.4	2.6	.49
15	Beef stew	3.2	2.6	1.1	1.6	2.5	2.5	.84
16	Soft maize-meal porridge	5.7	2.1	1.4	1.2	1.5	2.4	1.89
17	Jam	2.6	2.6	2	2.2	2	2.3	.30
18	Margarine	0	0	3.7	5.6	2.4	2.3	2.42
19	Coffee	2.6	2.3	1.2	1.3	2.1	2	.62
20	Polony	0	2.8	2	2.5	2.8	2	1.18
21	Rice	2	1.9	2.1	1.7	1.9	1.9	.18
22	Popcorn plain	1.8	0.9	3	2.5	1.1	1.9	.89
23	Mashed potato	3.1	1.7	1.8	1.5	0.7	1.8	.86
24	Cheese	2	1.6	2	1.7	1.8	1.8	.18
25	Non-dairy creamers	2.6	2.8	1.8	2	0	1.8	1.11
26	Liquid fruit juice/ceres	0.7	1.1	2.4	0.6	2.7	1.5	.98
27	Apple	2.1	1.6	1.2	0.9	1.3	1.4	.46
28	Chocolate	1.5	1.8	1.2	0.9	1.5	1.4	.34
29	Orange	1.8	1.6	0.9	0.9	0.6	1.2	.51
30	Cabbage	1.7	1	1	1.1	0.5	1.1	.43
31	Banana	1.3	1.4	0.9	0.9	1.1	1.1	.23
32	Ice cream	1	0.8	0.7	0.6	2.2	1.1	.65
33	Salad dressing	0.9	0.9	1	0.8	1.5	1	.28
34	Baked beans	1.2	0.9	0.9	0.7	1	1	.18
35	Fried fish	1.1	0.9	0.8	0.6	0.8	0.8	.18
36	Low-fat yoghurt	1.1	0.8	0.5	0.6	1.1	0.8	.28
37	Jelly	1.1	0.8	0.7	0.4	0.6	0.7	.26
38	Custard	0.9	0.7	0.6	0.4	0.7	0.7	.18
39	Pumpkin	1	0.9	0.6	0.6	0.3	0.7	.28
40	Mixed vegetables	0.8	0.7	0.4	0.5	0.4	0.6	.18
41	Samp and beans	0.8	0.5	0.4	0.4	0.5	0.5	.16

Tab. 5.2: Weekly frequency of consumption (mean and standard deviation) for only those children consuming the individual food item, ranked in descending order according to the mean frequency of consumption for all 5 interceptions

No.	**Food item**	**YEAR**					**Mean**	**SD**
		1995	**1997**	**1999**	**2000**	**2003**		
1	Sugar	7	7	7	7	7	7	0
2	Brown bread	7	7	6.4	6.5	6	6.5	.43
3	Tea	6.6	5.1	5.8	6	5.2	5.7	.61
4	Full cream milk	6.5	7	5.6	5	4.5	5.7	1.03
5	Oil	3.4	7	5.6	5.1	5.6	5.3	1.29
6	Butter	7	7	7	0	4.8	5.1	3.04
7	Stiff maize-meal porridge	5.5	4.6	5	5.3	5	5	.34
8	Liquid fruit juice/ceres	6	6.1	4.5	4.6	3.7	5	1.04
9	Sweets	4.5	6.3	4	3.7	4.8	4.7	1.01
10	Non-dairy creamers	5.4	5.4	6.3	5	0	4.4	2.52
11	Crisps	4	5.4	4.4	3.8	4.1	4.3	.63
12	Peanut butter	5.4	4.6	3.8	3.2	3.8	4. 2	.85
13	Soft maize-meal porridge	6.5	5	2.5	2.5	3	4	1.78
14	Margarine	1	0	6.6	6.2	4.7	3.7	3.03
15	Coffee	5.3	3.4	3	2.5	3.7	3.6	1.06
16	Eggs	4.4	2.8	4	3.3	3	3.5	.68
17	Biscuits	3.3	3.7	3.2	3.3	4.1	3.5	.38
18	Jam	4.1	3.2	2.8	2.8	3.5	3.3	.55
19	Carbonated beverages	4	3.3	3.1	2.6	3.6	3.3	.53
20	Cheese	3	2.2	3	2.8	3.4	3	.44
21	Chicken	2.5	2.4	2.2	3.1	3	2.8	.39
22	Mashed potato	3.8	2	2.2	2.1	2.8	2.6	.75
23	Popcorn plain	2.5	2	3.7	3	3	2.3	.75
24	Beef stew	3.3	2.5	2.7	0	2.9	2.3	1.31
25	Chocolate	2.2	2.2	2.1	2	2.6	2.2	.23
26	Ice cream	2	1.5	2.4	1.8	3.1	2.2	.62
27	Low-fat yoghurt	2	1.6	2	1.6	2.3	2.2	.30
28	Apple	2.4	1.9	1.8	1.8	2.3	2.1	.29
29	Rice	2	2	2.2	1.8	2.1	2	.15
30	Polony	0	0	2.6	3.1	4.1	2	1.87
31	Orange	2.2	2	1.6	1.7	1.8	2	.24
32	Banana	2	1.8	1.5	1.5	2.1	2	.28
33	Cabbage	1.8	1.4	1.4	1.6	2.2	1.7	.33
34	Baked beans	2	1.3	1.5	1.4	2.2	1.7	.39
35	Salad dressing	1.3	1.5	1.6	1.3	2.4	1.6	.46
36	Mixed vegetables	1.5	1.5	1.1	1.4	2.3	1.6	.45
37	Custard	1.4	1.1	1.3	1.2	1.8	1.4	.27
38	Fried fish	1.5	1.2	1.1	1.1	1.7	1.3	.27
39	Samp and beans	1.3	1.1	1.2	1.2	1.6	1.3	.19
40	Pumpkin	1.4	1.3	1.1	1.3	2.2	1.2	.43
41	Jelly	0.8	1	0.6	1	0.7	0.8	.18

by those children consuming sugar. This was followed by brown bread being consumed on average 6.5 times/week. Tea, full cream milk, oil, butter, stiff maize-meal porridge and fruit juice were consumed 5x/week or more by those children consuming them. The remaining items of the top 13: sweets, non-dairy creamers, crisps, peanut butter and soft maize-meal were consumed on average 4x/week. The remaining 28 food items were consumed between 0.8 and 3x/week by only those children consuming them.

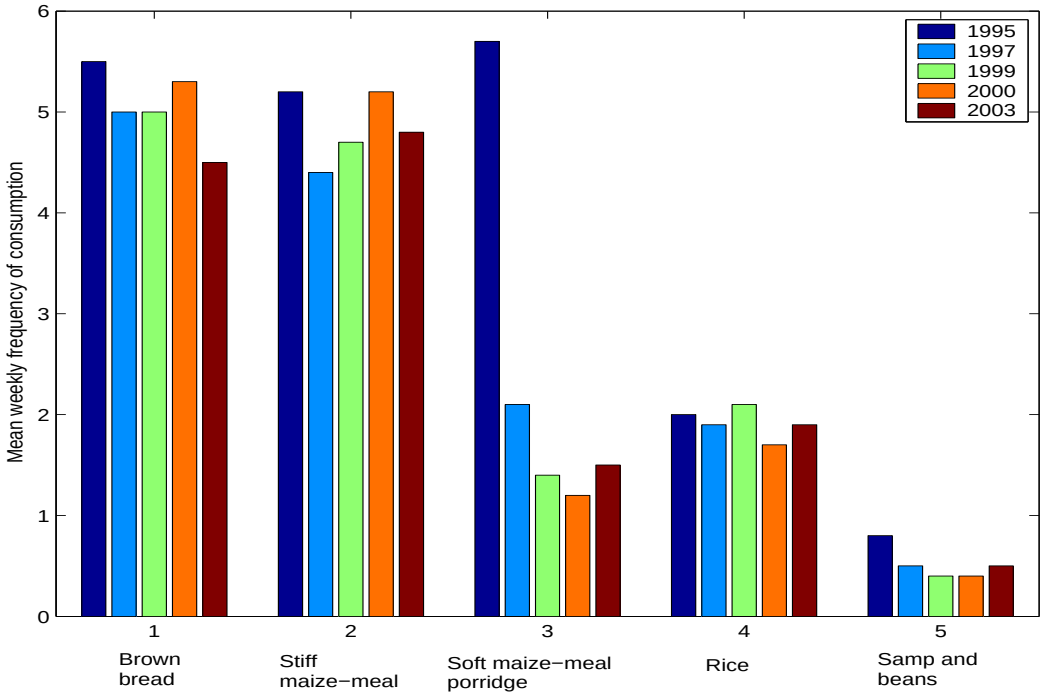


Fig. 5.1: Mean weekly frequency of consumption of grain/cereal/breakfast cereal/porridges and other starches for all the children [n=143] at each interception.

Showing the frequency of consumption of the grain/cereal/breakfast cereal/porridges and other starches ranked in descending order within food groups for all the children in (fig. 5.1), it appeared they followed the traditional trend in the consumption of these items. Of the five food items from this food group, only soft maize-meal porridge was consumed 6x/week in 1995 but decreased to 1-2x/week from 1997-2003. Brown bread and stiff maize-meal porridge were consumed on average 5x/week for all interceptions. The mean consumption of rice ranged from 1.7-2x/week, while samp and beans was consumed by the children only 0.4-0.8x/week for all interceptions.

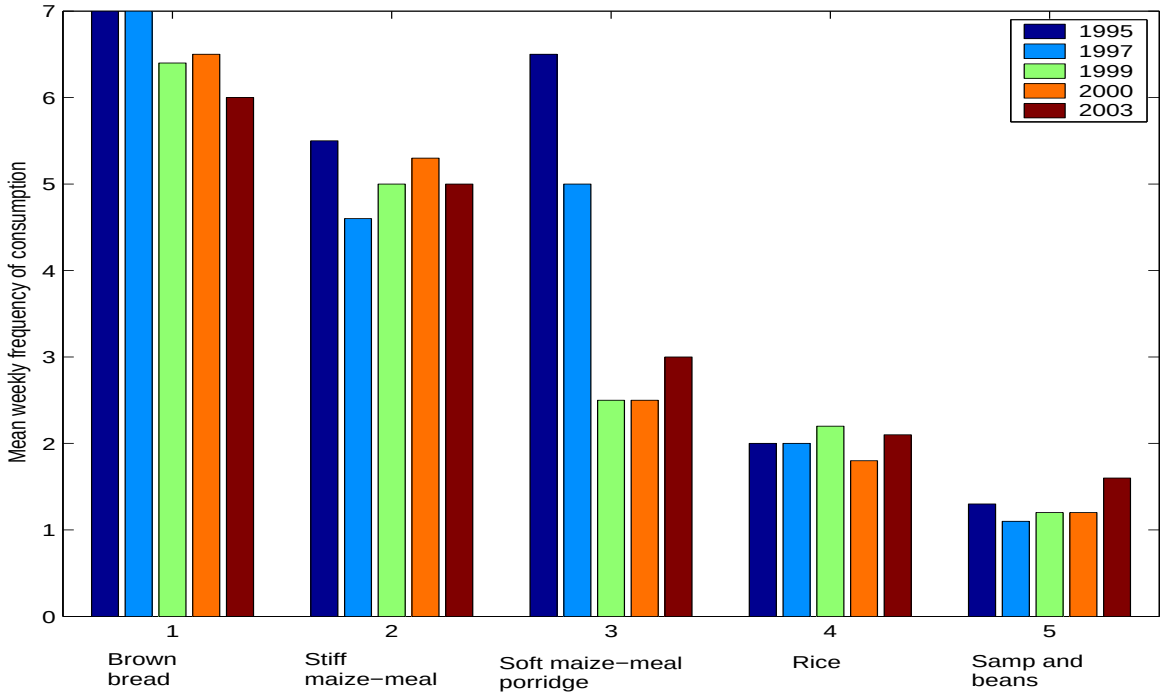


Fig. 5.2: Mean weekly frequency of consumption for only those children consuming grain/cereal group/breakfast cereal/porridges and other starches at each interception.

For only those children consuming the items from the grain and cereal group (Fig. 5.2), brown bread was consumed almost everyday over the eight-years. The children who consumed soft maize-meal porridge did so 5-6x/week in 1995 and in 1997. Thereafter it decreased to between 2.5-4x/week from 1999 to 2003. The frequency of consumption of the other cereals and grains (stiff maize-meal porridge, rice and samp and beans) were consumed fairly consistently over the 5 interceptions for those children who consumed them.

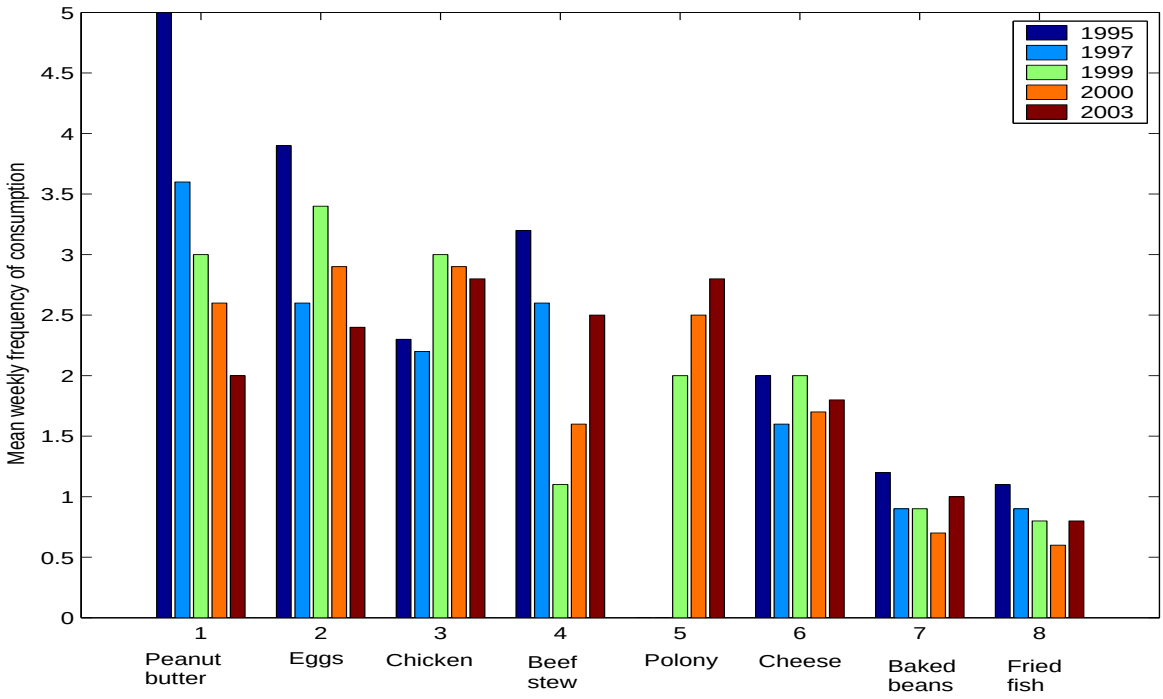


Fig. 5.3: Mean weekly frequency of consumption of meat and meat substitutes for all the children[n=143] at each interception.

In the group of meat and meat substitutes for all the children, peanut butter was the most frequently consumed food item in 1995 (5x/week), decreasing stepwise to 2x/week in 2003. Eggs were consumed most frequently in 1995 (3.9x/week). Chicken showed an increase in consumption after 1997, from about 2x/week to 3x/week. The frequency of consumption for fried fish, cheese and baked beans remained fairly constant over the 5 interceptions (Fig. 5.3).

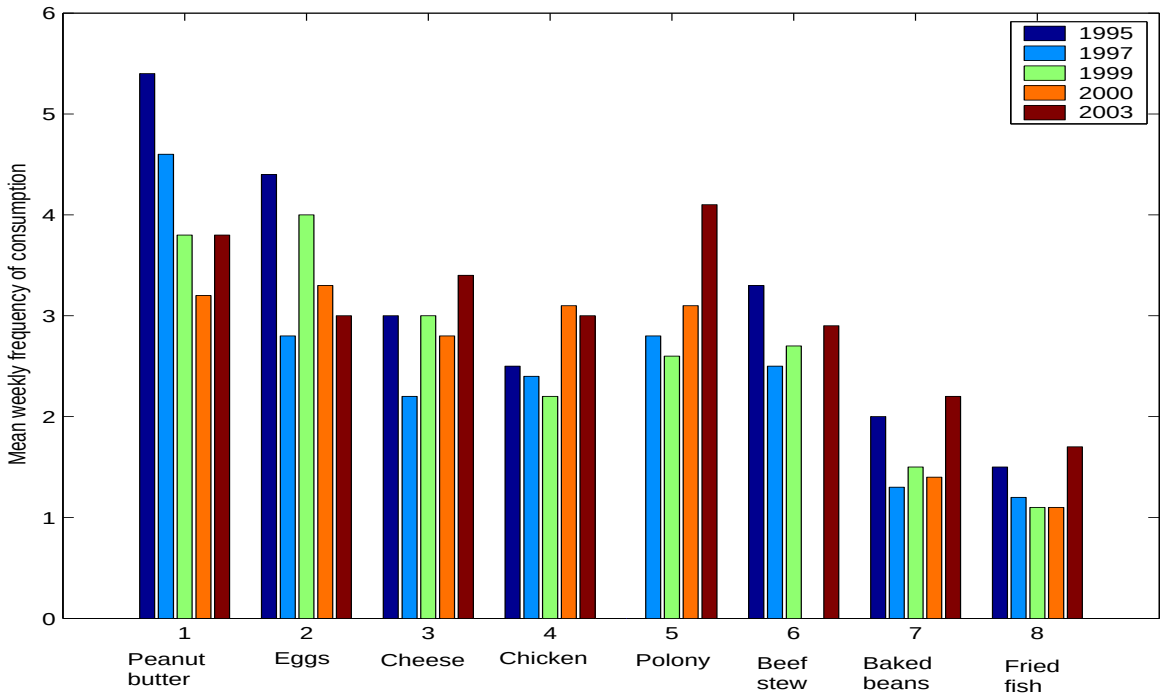


Fig. 5.4: Mean weekly frequency of consumption for only those consuming meat and meat substitutes at each interception.

Fig. 5.4 shows the frequency of consumption for only those children consuming meat and meat substitutes. Peanut butter was again the most popular food item among the meat substitutes for those children. In the 1995 interception these children consumed peanut butter 5.4x/week, decreasing gradually to 4.6x/week in 1997, and 3.8x/week in 1999. Peanut butter, eggs, chicken and polony were consumed approximately 3x/week in 2000, while consumption of polony for only those children consuming it increased significantly above other meat and meat substitutes in 2003 interception (4.1x/week).

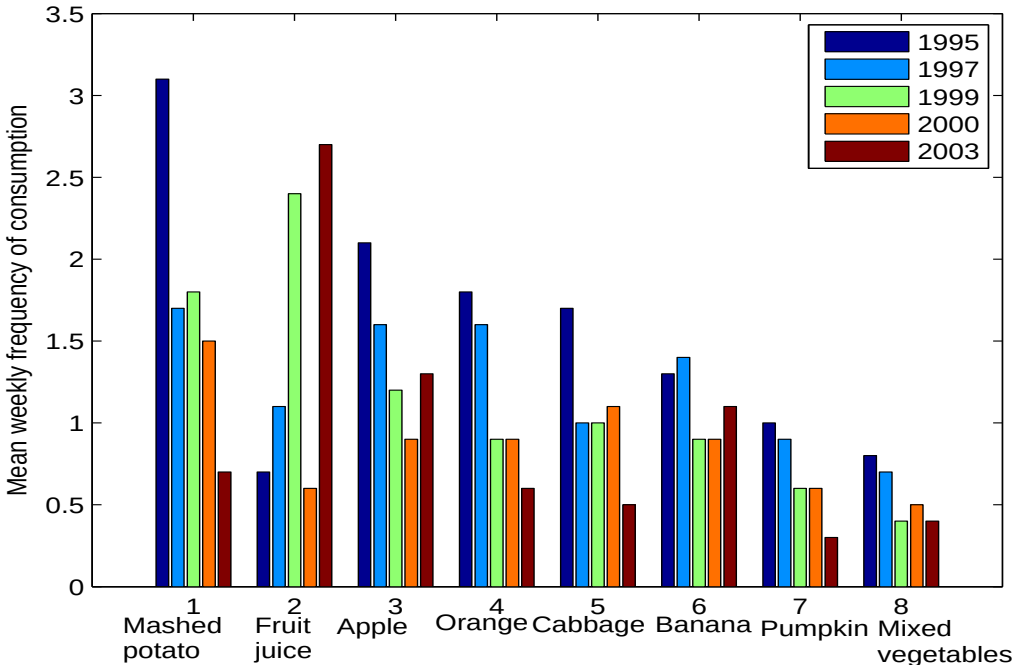


Fig. 5.5: Mean weekly frequency of consumption of fruits and vegetables for all the children [n=143] at each interception.

Fig. 5.5 shows the downward trend in the consumption of fruits and vegetables during the eight-year period. The general consumption of this group was not more than 3x/week for all the children, with most items being consumed less than 1.5x/week. The most frequently consumed items that featured within the top 41 items were mashed potato, cabbage, mixed vegetables and pumpkin among the vegetables and apples, banana and oranges among the fruits. Mashed potato (3x/week in 1995) and fruit juice (2.4x/week in 1999 and 2.7x/week in 2003)were the most frequently consumed items. Fruit juice intake increased dramatically in 1999 to 2.4x/week and then decreased in 2000 to 0.6x/week, increasing again in 2003 to 2.7x/week. Surprisingly, in the year 2003, all fruits and vegetables consumption decreased except fruit juice intake which was even less than 3x/week.

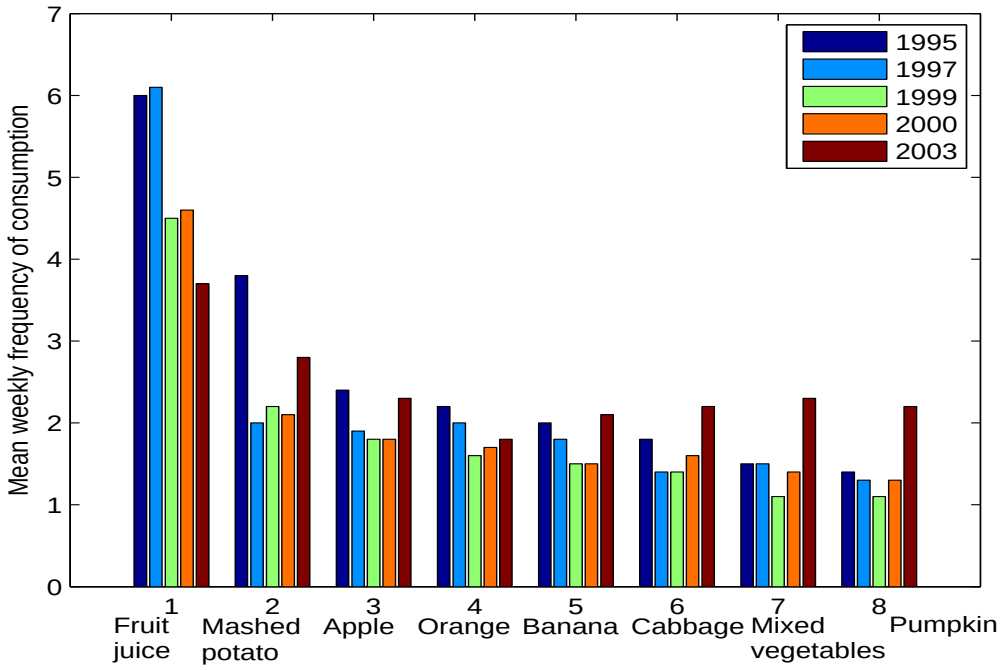


Fig. 5.6: Mean weekly frequency of consumption for only those consuming fruits and vegetables at each interception.

The frequency of consumption of fruits and vegetables for only those consuming them is shown in Fig.5.6). The children who consumed fruit juice did so 6x/week in 1995 and 1997, thereafter the frequency of consumption decreased, the lowest consumption being 3.7x/week in 2003. The children who consumed fruits and vegetables from the top 41 items generally did so less than 2x/week. Among the vegetables, mashed potato was consumed most frequently throughout the 5 interceptions and apples and banana were consumed almost the same as oranges among the fruits.

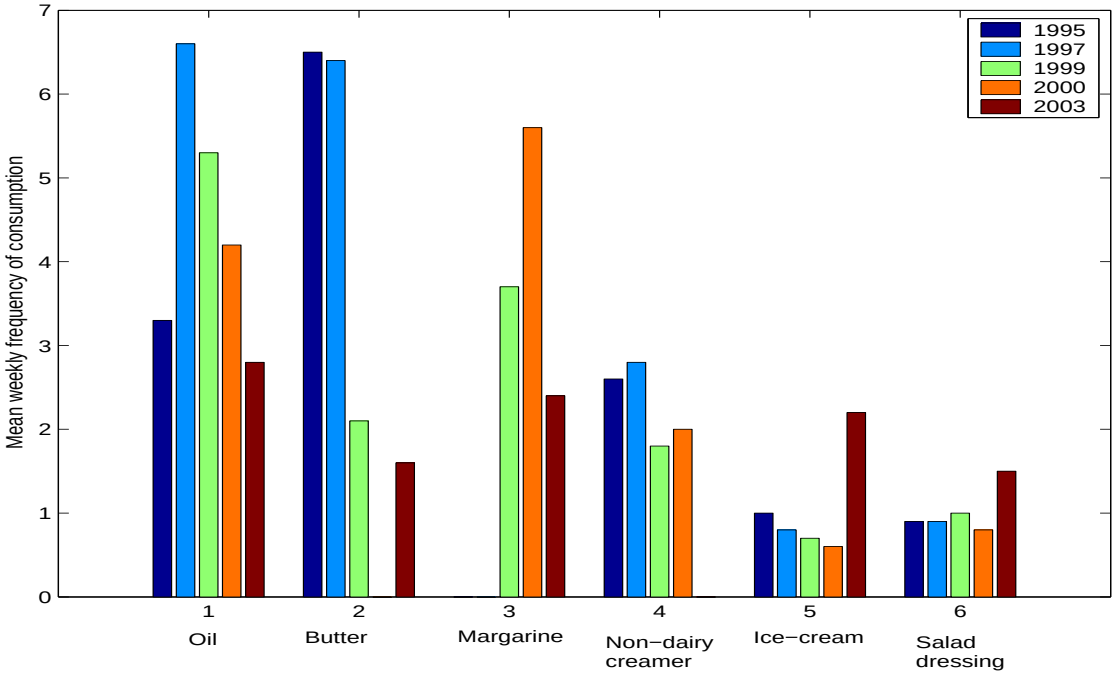


Fig. 5.7: Mean weekly frequency of consumption of fats and oils for all the children [n=143] at each interception.

Fig. 5.7 shows the frequency of consumption of the sources of fats and oils for all the children. The most frequently consumed fats and oils were butter, oil and margarine, while the least frequently consumed were ice-cream and salad dressing. The frequency of consumption of butter decreased dramatically from 6x/week in 1995 and 1997 to approximately 2x/week in 1999 and 2003. Alternatively, oil consumption increased from 1995 (3x/week) to 1997 (6.6x/week) and then decreased stepwise to just under 3x/week in 2003. The frequency of consumption of both ice-cream and salad dressing increased in 2003, while all other fats and oils decreased for this interception. The highest consumption of margarine was in 2000 (5.6x/week).

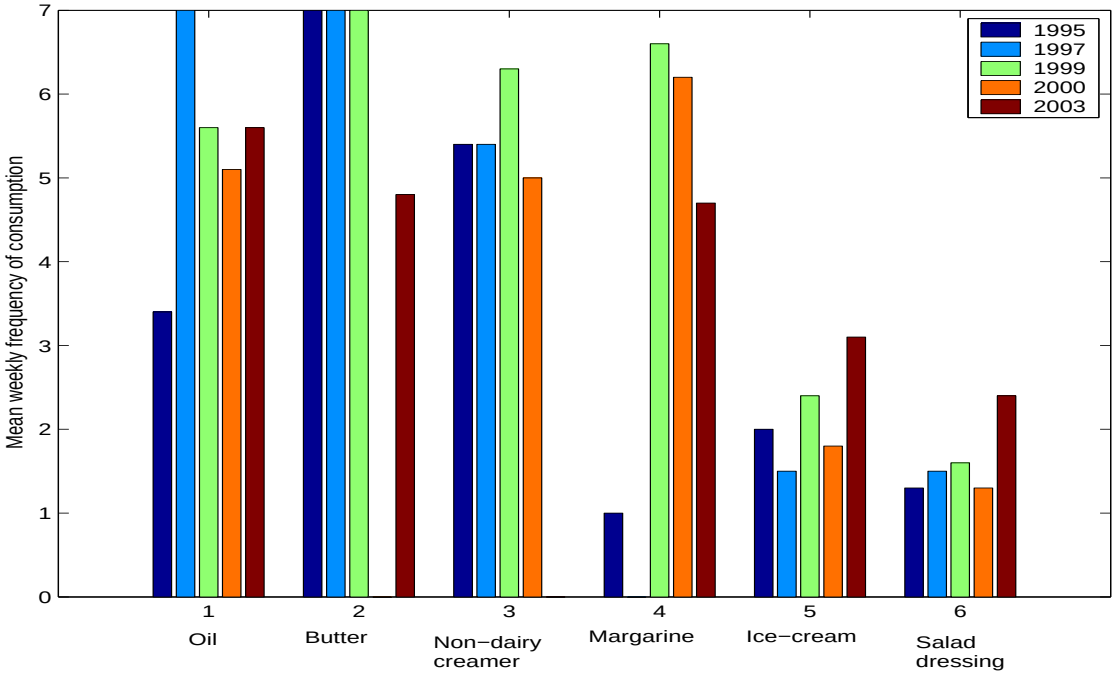


Fig. 5.8: Mean weekly frequency of consumption of fats and oils for only those consuming fats and oils at each interception.

The mean weekly frequency of consumption for only those children consuming fats and oils are presented in Fig. 5.8. There was a high frequency of intake of butter for the first three interceptions (7x/week), and oil intake for the 1997 interception was consumed almost every day (7xweek). The frequency of consumption of margarine for those children consuming it increased in 1999 and 2000 to 6.6x/week. Consumption then decreased to 4.7x/week in 2003. Those children who consumed oil did so most frequently in 1997 (7x/week). Non-dairy creamers were consumed 5-6x/week from 1995-2000 but were not consumed in 2003, while the consumption of salad dressing increased to 2.4x/week in 2003.

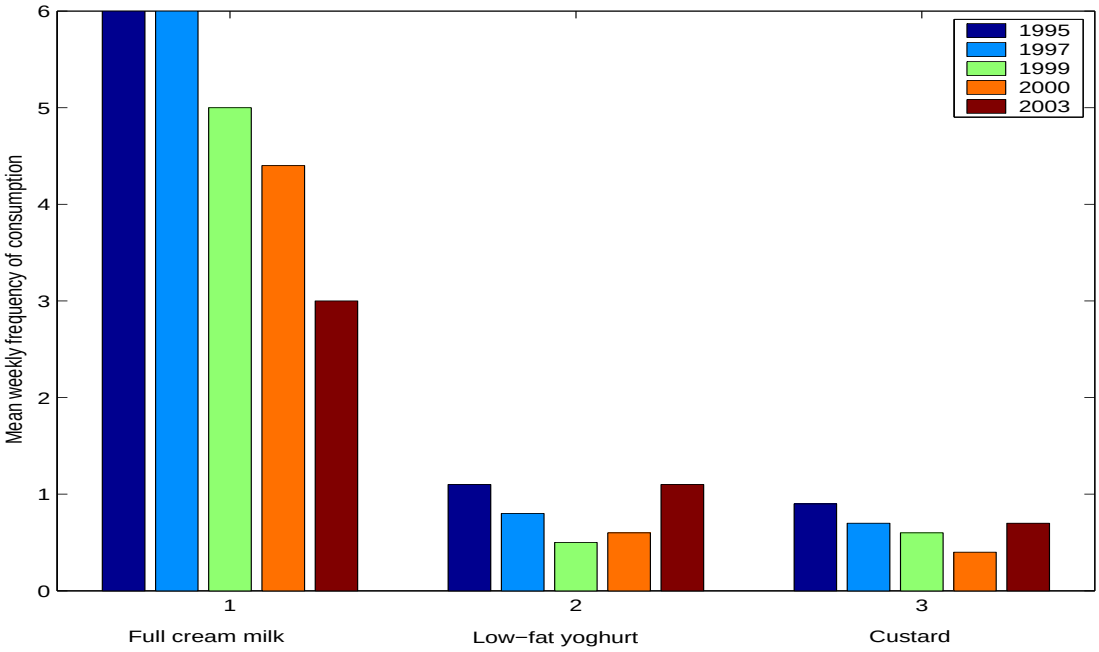


Fig. 5.9: Mean weekly frequency of consumption of milk and milk products for all the children.

Among the milk and milk products, full cream milk was consumed most frequently by all 143 children at all 5 interceptions (Fig. 5.9). The frequency of consumption ranged from 6x/week in 1995 and decreased stepwise to 3x/week in 2003, interception. The children consumed low-fat yoghurt 1.1x/week in 1995 and 2003, while the consumption of custard was highest in 1995, being consumed almost once a week.

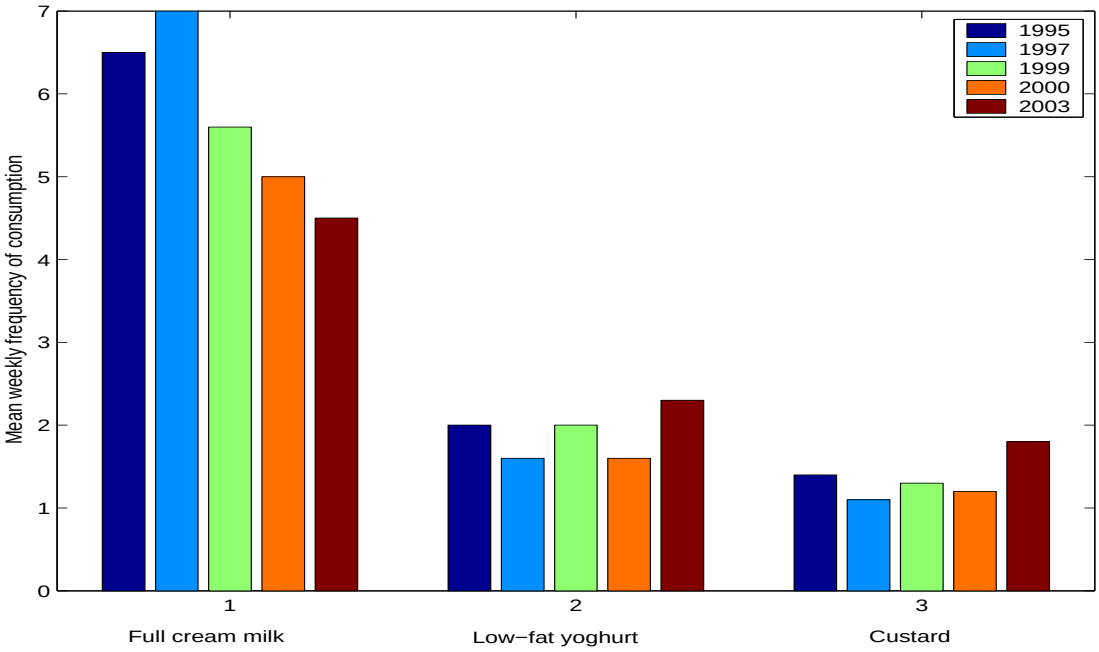


Fig. 5.10: Mean weekly frequency of consumption for only those consuming milk and milk products.

Fig. 5.10 shows the frequency of consumption of milk and milk products for only those children consuming them. Full cream milk was again the most frequently consumed item for all 5 interceptions. In 1995, intake of full cream milk was 6.5x/week, increasing slightly in 1997 interception to 7x/week and then there was a stepwise decrease to 4.5x/week in the 2003 interception. The children who consumed low-fat yoghurt and custard did so between 1.1 to 2x/week over the 5 interceptions, respectively.

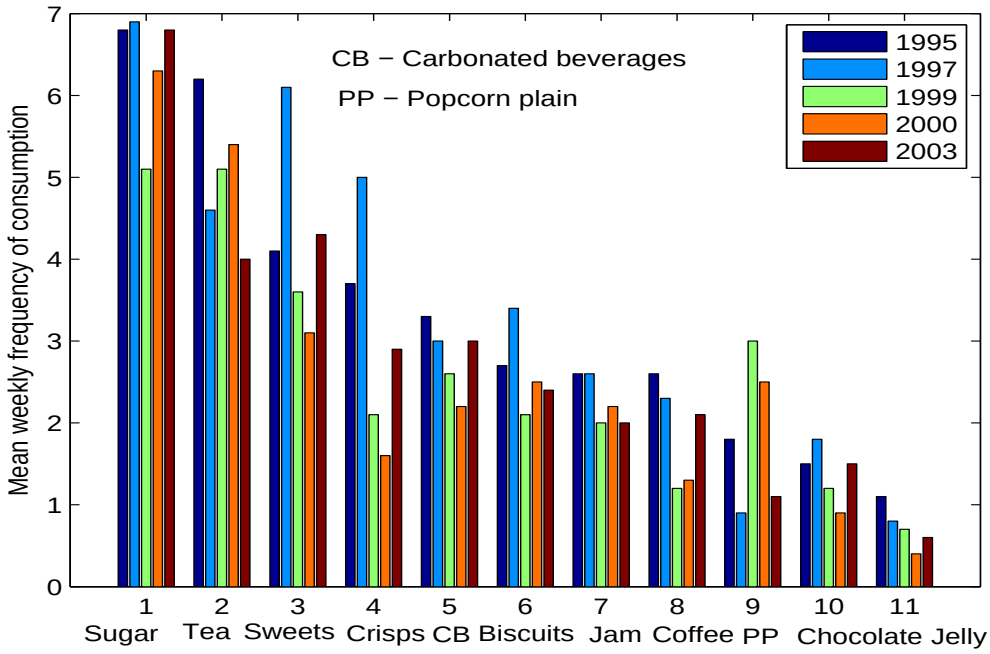


Fig. 5.11: Mean weekly frequency of consumption of miscellaneous foods for all the children [n=143] at each interception.

Looking at the miscellaneous group (Fig. 5.11) sugar was the most frequently consumed food item for all interceptions for all 143 children. However, both tea and sugar were consumed most frequently (5x/week) in 1999. Eleven food items out of 41 top food items recorded fell into the miscellaneous group of foods at all 5 interceptions. Jelly was consumed the least frequently (less than 1x/week) by all the children. Carbonated beverages were consumed approximately 3x/week in 1995 but decreased stepwise to 2.6x/week in 1999 and then increased again in 2003 to 3x/week. Surprisingly the highest consumption for coffee was 2.6x/week in 1995 when the children were 5 years. However, for all interceptions tea was consumed more frequently than coffee. Sweets were consumed most frequently in 1997 (6.1x/week) followed by 4.3 times in 2003.

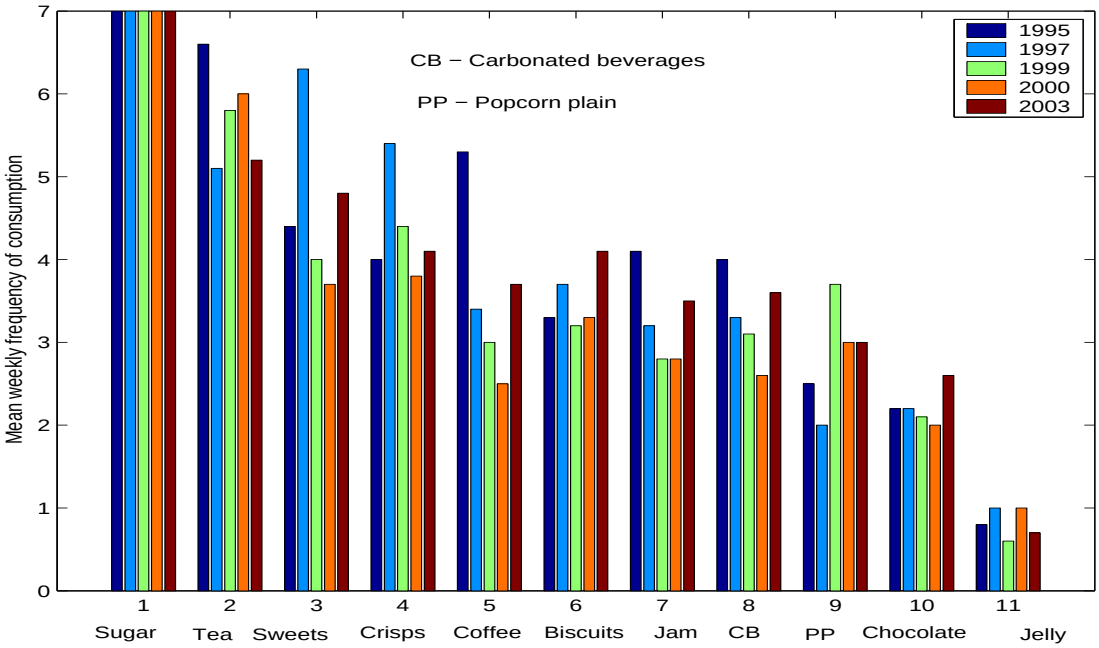


Fig. 5.12: Mean weekly frequency of consumption for only those consuming miscellaneous foods at each interception.

The mean weekly frequency of consumption for only those children consuming the miscellaneous foods are presented in figure 5.12. Again, sugar was consumed most frequently (7x/week) among these items for those children who consumed it at all 5 interceptions. Tea was consumed most frequently by only those children consuming it in 1995 (6.6x/week). The children who consumed sweets did so most frequently in 1997 (6.3x/week). However, the highest consumption of carbonated beverages was in 1995 (4x/week), decreasing stepwise in 1997, 1999 and 2000 but increasing again in 2003 to 3.6x/week. The highest consumption of crisps (5.4x/week) was recorded in 1997. Biscuits were consumed most frequently in 2003 by these children consuming them (4.1x/week).

5.3 Discussion

5.3.1 Main findings

The most frequently consumed food item among grain/cereal group/breakfast cereal/porridges and other starches was brown bread. The mean weekly frequency of consumption was 5x/week for all the children and this item was consumed almost everyday (6.5x/week) for only those consuming it over the eight years. Stiff maize-meal porridge was consumed almost 5x/week for all the children and for those consuming it, while the mean frequency of consumption of soft maize-meal porridge was only 4x/week for only those children consuming it from 1995 to 2003. Brown bread and stiff maize-meal porridge are the staple foods and it will be appropriate to fortify them in order to increase nutrient intakes of these children.

The 143 urban black children consumed chicken, eggs and peanut butter almost 3x/week and 3-4x/week for only those children consuming these items from the group of meat and meat substitutes.

Additionally, it is quite worrisome that during the eight-year of nutrition interception, there was not any daily consumption of fruits and vegetables. The mean frequency of of consumption of fruit juice was 1.5x/week for all the children and 5x/week for only those children consuming it. Among the vegetables, mashed potato was consumed 1.8x/week for all the children and 2.6x/week for only those who consumed this item decreased over the 8 years.

Within the fats and oils food group, butter and cooking oil were the most frequently

consumed items (3-4x/week) for all the children and (5x/week) for only those children who consumed them over the 5 interceptions.

The mean intake of full cream milk was 5x/week for all the children while the mean intake for those children who consumed it was 6x/week.

Sugar was consumed daily at all interceptions for those children who consumed it and 6x/week for all the children. The frequency of consumption of sweets and tea for all the children was 4-5x/week, while for only those children who consumed them it was 5-6x/week.

5.4 Conclusions

The South African Food Based Dietary Guidelines specifically emphasized on daily consumption of certain food items such as starchy foods, vegetables and fruits, meat, fish, chicken, eggs and milk. On the average, the subjects in the present study did not follow very healthy dietary patterns except for eating starchy food and brown bread daily. In fact, the most positive change among the 41 food items recorded by the children was the frequent consumption of brown bread, while it is quite alarming that the consumption other food groups decreased and most importantly the children consumed miscellaneous food items (sugar, tea, sweets, crisps, carbonated beverages, biscuits, jam, coffee, popcorn plain, chocolate and jelly) consistently over the period of investigation.

6. GENERAL DISCUSSIONS

6.1 Main findings

The main findings of the present study showed that five hundred and forty-six food items were recorded by the longitudinal group of urban black children and these items were recorded 23840 times from 1995 to 2003. Only forty-one food items contributed 1% or more of the total number of recordings. Rice was the top food item, being recorded 684 times, followed by stiff maize-meal porridge 676 times. Both food items contributed just under 3% of the total number of recordings for all the food items for all interceptions. Although, the percentage of children who consumed rice and stiff maize-meal porridge was above 90% compared to brown bread (78%), the mean weekly frequency of consumption of brown bread was the highest over the period of eight-years. Those children who consumed brown bread did so almost everyday, while it was consumed 5x/week for all 143 children. Stiff maize-meal porridge was consumed 5x/week and rice 2x/week for all the children as well as for only those consuming these items.

However, only chicken and eggs were among the top ten food items recorded from the meat and meat substitutes. The total number of recordings for chicken was 672 times and eggs 642 times, respectively. Only 88-94% of the children consumed these two food items. The most frequently consumed food items within this food group for

only those consuming them were peanut butter (4x/week) and eggs (3.5x/week) and for all the children these two items were consumed 3x/week.

The variety of vegetables and fruits recorded was limited and only four food items (apple, banana, mashed potato and cabbage) from this food group each contributed 2% to the total number of recordings from 1995 to 2003. However, 70% of the children consumed apples and 68% consumed mashed potato. Fruit juice was the most frequently comsumed food item (5x/week) for only those children who consumed it. Mashed potato was less frequently consumed (1.8x/week) for all the children than for only those children who consumed it (2.6x/week).

Oil, which ranked tenth among the top 41 food items was recorded 599 times and contributed 2.5% to the total number of recordings. Interestingly, 84% of the children consumed oil. The children who consumed oil and butter did so 5x/week. The mean frequency of consumption of ice cream increased to 1x/week for all the children and 2x/week for only those consuming it over the period of eight-years.

Within the milk and milk products, only full cream milk was among the top food items. It was recorded 616 times and contributed 2.6% to the total number of recordings. Eighty-six percent of this longitudinal group of urban black children consumed full cream milk and it was the most frequently consumed food item from this food group. The children who consumed full cream milk did so 6x/week.

Eleven food items out of the top 41 food items recorded were from the miscellaneous

group of foods. The number of times sugar, sweets, tea and carbonated beverages were recorded ranged from 600 to 657 times and they contributed between 2.5%-2.8% of the total number of recordings for all five interceptions. Although, 84%-92% of the children consumed the above listed food items, sugar (6-7x/week), tea (5-6x/week), sweets (4-5x/week) and crisps (3-4x/week) were the top 4 most frequently consumed items for all 143 children as well as by only those children who consumed them.

6.1.1 Comparison with other studies in South African

Many longitudinal research studies have shown that food habits change over time [96, 98, 100, 117], but there is paucity of data on longitudinal assessment of actual food item intakes of communities in South Africa to show this change over time. However, findings on individual food items by the very young rural black children [42, 113], rural and urban preschoolers [113, 116] [141] – [143], and older children from cross-sectional studies in South Africa are available [34, 86, 141, 144]. The results of this study are specific to this group of children and cannot be extrapolated to other communities, age groups, or areas. True comparison with other studies can thus not be made.

The only comparative longitudinal nutrition study that has been conducted on these same Bt20 urban black children was on their macro-and micronutrient intake at four interceptions between 1995 and 2000. It was concluded that the nutrient intake of these children deteriorated between 1995 and 2000. These urban black children had the best nutrient intake at 5-years in 1995 when the lowest percentage fell below the RDA for most nutrients while the worst nutrient intake was at 10-years with the high-

est percentage of the children falling below the RDA [117].

Although no individual food items were studied, based on the fact that an increased number of food items (variety) results in an improved nutrient intake, the highest (1995) and the lowest (2000) nutrient intake did not correspond with the highest number of food items recorded (1999) and the lowest (1997) in the present study. It could be that more foods of low nutrient density were consumed in 1999. This could possibly have resulted from an additional interception in the present study in 2003 and the use of different food codes by the coders.

With regards to the grain/cereal group/breakfast cereal/porridges and other starches, both soft and stiff maize-meal porridge have been, and are still, a staple food among the black community in South Africa [39, 42, 45, 127, 71, 81, 85, 86, 111, 145, 80]. The most recent National study on children, aged 1-9 years is the National Food Consumption Survey, reported rice to be among the most commonly consumed food items [30]. Although, rice being the top food item recorded was only consumed +/- 2x/week and stiff maize-meal was more frequently consumed in the present study.

Of the nutrition intervention studies on South African children, none have reported the percentage of children consuming the individual food items in a longitudinal cohort, but Mackeown and Faber [39] investigated the frequency of food items consumed by young rural and urban South African children from 4-24 months. Soft maize-meal porridge was consumed by 73% for both rural and the urban Soweto children. Seventy four percent of the urban Soweto chidren consumed brown bread, while only 61% of children from the rural area consumed rice. In addition, stiff maize-meal porridge was

consumed by 56% of the urban Soweto children and 62% of the urban Johannesburg children.

Another study of adult South Africans from all ethnic groups and provinces between 1983 and 2000 reported on the variety and average intakes of food items consumed. Rice and maize were also among the top food items consumed by more than 80% and 78% of all the subjects, respectively [146]. In addition, 60%–80% of these adult group consumed brown bread.

Although true comparison cannot be made, the percentage of children who consumed rice, stiff maize-meal porridge and brown bread reported in this thesis corresponded with the high percentage of these items reported in the above listed studies.

The findings of the present study also compared favourably with Mackeown and Faber's [39] study on the most frequently consumed food items from this food group. There were similarities in the frequency of consumption for brown bread and rice for the urban black children, being consumed 5 and 2x/week, respectively. It appears that brown bread and rice have also become popular staples among this community.

Similar to the findings in the present study, many cross-sectional studies in South Africa have shown chicken and eggs to be popular food items among meat and meat substitutes. As stated by Mackeown [71] chicken is economical, versatile and also low in fat [71, 29], but only a few studies have explored consumption of eggs among South Africans as eggs are often used in dishes and baked products [61]. However, Mackeown

[113] found eggs to be a popular protein source as they featured within the top 25 food items for all the ethnic groups examined [113] and Africans from the North West Province of South Africa consumed eggs between 0.4 times to 1.2 times per day [81].

Despite a growing awareness of the benefits of fruits and vegetables, a steady decrease in consumption of fruits and vegetables was noted in the present study. Fruit consumption among South Africans has been strongly related to availability and highly contingent on seasonal fluctuation [57, 71]. The cheaper variety of fruits (apples, banana and oranges) available throughout the year are generally consumed [71]. Other studies conducted in South Africa on different communities have also shown a low intake of vegetables and fruits [57, 71, 81, 80, 145, 147, 139].

In contrast to the present study, eighteen different fruits and vegetables were reported in the study conducted by Mabckeown and Faber on the frequency of food items consumed by young rural and urban children [39]. The top fruit being banana was consumed by 65% to 78% of the subjects and on the average 64% of the participants in the present study consumed banana but the variety of these items in the present were just eight over five interceptions. Mackeown and Faber [39] and this study also found that apple was consumed 1.4x/week.

Studies have shown an increase in consumption of margarine and oil over time [30, 42, 79]. The present study did not find an increase in intake of oil over the 5 interceptions, but it was an important item in the diets of these children as it featured within the top 10 food items. Apparently, the respondents were asked to estimate on average

the total amount of butter, margarine and oil used per week but few people report actually eating oil, but oil is frequently used in cooking [30].

It should be noted that this study population probably confused the use of butter and/or margarine because when the number of recordings of both food items were added, the consumption pattern would have changed given different result. The interviewers did not emphasize when asking whether it was butter, hard or soft margarine that was used. This is possibly a potential weakness in the study.

A study of adult South Africans from all ethnic groups and provinces between 1983 and 2000 reported on the variety and average intakes of food items consumed. Medium/low fat spreads were consumed by more than 80% of all the subjects and 60%–80% of these adult group consumed salad dressing [146]. The present study reported salad dressing to be consumed by 64% of the children. Although, there was confusion between butter and margarine in the present study as mentioned above, regular intake of hard margarine has been reported in other South African studies [86, 148].

Within this food group, intake of ice-cream increased from 1995 to 2003 among these children. The consumption of ice-cream was also noted in Mackeown and Faber's study [39]. Although, 48% of this urban black children who consumed ice-cream was higher than Mackeown and Faber's study, the frequency of consumption was similar in both studies (2.2x/week) for all the subjects examined.

Several studies have also reported similar low intake of milk [111, 139, 42, 71, 76, 81, 85, 86, 145, 139, 149] and many South African researchers have consistently re-

ported an inadequate intake of milk products [13, 42, 79, 111, 150, 145, 139] and this is in support of the results obtained from the present study. This could possibly be explained by the fact that the black community is known to have a lactose intolerance [61].

A study conducted by Langenhoven *et al* in 1988 [115] revealed that milk consumption among coloureds, whites and Xhosa were lower than the recommended allowance and other studies have reported the same trend [45, 81, 148]. Furthermore, an investigation was conducted on 2000 South African households almost ten years later [151]. The result showed that half of the respondents drank less than 200ml per day.

According to Scholtz [61], milk has always been a favourite food among blacks and it is usually consumed as sour milk or added to porridge which is generally well tolerated by those who are lactose intolerant [61]. However, only small children and the elderly drank fresh milk and numerous taboos and rituals influenced its consumption in the past [61, 71]. Hence, continuous low intake might be due to lactose intolerance, unavailability, culture, tradition and most importantly affordability because dairy products are relatively expensive in South Africa and consumption pattern can be expected to be influenced by price [61, 71].

It is important to note that previous South African studies have reported the excessive intake of food items such as sugar, tea and coffee. Walker, conducted a study on nutritional, biochemical, and other studies on South African populations in 1966 [111]. Within the miscellaneous food group reported in that study, sugar, tea, and coffee were being introduced among the rural blacks while increased consumption of

soft drinks were noted with the above listed food items among the urban blacks [111]. Tea and coffee have been consistently reported as the usual beverage among both rural and urban black communities in South Africa [30, 71, 86, 111, 139, 146].

More recently, the National Food Consumption Survey was of children 1-9 years old reported that seventy-six percent of the children drank tea [30, 146]. However, a study on very young children in Soweto [39] showed that 62% drank tea compared to 90% of children in the present study. Similar trends were observed with respect to the mean weekly frequency of consumption of tea (5x/week) for the young urban Soweto children and for all the children in the present study.

With regards to sugar, other researchers have also reported a high consumption among children and found that it had remained relatively constant among 5-year-old urban black children living in the Johannesburg/Soweto area between 1991 and 1995 (78 g/day) [152] and many children in Faber's study also reported drinking tea with sugar regularly [86]. In addition, findings from MacIntyre's study [80] on dietary intakes in different stages of transition in the North West Province (THUSA study) revealed that white sugar was consumed by almost all the participants.

Seventy-seven percent of the participants in the National Food Consumption Survey consumed sugar. [30, 146]. However, the present study generally found over 90% of children consumed sugar from 1995 to 2003 and this confirms regular intake of sugar among South Africans [30, 71, 81, 111, 139].

Mackeown and Faber [39] reported that the mean weekly frequency of consumption of sugar among young rural South African children was (6x/week) and this is similar to the present study's findings for all the children (6.4x/week). On the other hand, in the group of miscellaneous food items, other authors have shown an increased intake of sweets, crisps, carbonated beverages and chocolate over time [86, 76, 146].

In a study on the measurement of dietary patterns of a representative sample of 10 to 15 year old children from both rural and urban schools conducted in the North West Province of South Africa, 24% of these South African children consumed potato crisps and fried maize snacks (fritos,etc) [76]. In addition, a high consumption of sweets and chocolates (70%) was reported in Faber's study on dietary intake of primary school children in relation to food production in a rural area in KwaZulu-Natal [86] and 60%-80% of adult South Africans from all ethnic groups and provinces between 1983 and 2000 consumed carbonated beverages [146].

The present study also showed a high percentage of the Bt20 children consuming sweets (91), carbonated beverages (82%), crisps (71%), and chocolate (62%). The mean frequency of consumption of carbonated beverages in the present study was 3x/week and this was also noted in Mackeown and Faber's [39] study for the young rural and urban Soweto children. Thus, the results of the present investigation are largely consistent with other cross-sectional studies conducted in South Africa.

6.1.2 Comparison with other studies in other developing countries

The analysis of the literature clearly indicated that very little, or no information, is available on the longitudinal food item intakes in the third world countries. The no-

tably lack of systematic studies on food item intakes among school children limits detailed discussion with other studies in Africa specifically.

Nevertheless, a study conducted by the World Bank in three different countries namely Kenya, Mexico and Egypt on the dietary quality of toddlers before and after weaning showed an energy deficit and the diet quality of these children to be a problem especially in Kenya and Mexico [153]. Consumption of maize had, and is still, being reported as a staple food item among black Africans [9, 112, 154, 153]. This was also reported in the Kenya project conducted on school children from the age of 7 to 9 years and on a subsample of children 12 to 14 years. In that investigation maize-meal was the main dietary staple and millet and sorghum were used occasionally. In addition, consumption of eggs, meat or fish were reported but generally animal products and animal protein by the subjects examined were very low [112]. Within the fruits and vegetables, only beans, green leaves and other vegetables were reported and the participants consumed these items with maize. The use of cow's milk was used only with tea or for infant feeding. Thus the energy intake of the sample was between 75% and 80% of the recommended energy intake [112]. The results of this study compared favourably well with the listed staple food items in the present study; with the number of recordings for rice and maize-meal being fairly high during the 5 interceptions. However, the number of recordings for meat and meat products in the present study was higher than the Kenya study. Food items from this group remained fairly stable in the present study with an increased consumption of polony in 1997. Low intake of milk, fruits and vegetables were observed among Kenya children [112] and this is consistent with results of this investigation.

Among dietary studies in countries experiencing a health transition, Romieu reported frequent consumption of fast foods [84] and erratic food intake was also noted among children in a study conducted in Nigeria [155].

However, in a six-year follow up of dietary intakes of Chinese from childhood to adolescence on macronutrient and major food groups such as vegetable and fruit, meat and edible oil, there was stability of consumption of high carbohydrate, high vegetable and high meat diets among half of the participants after the six year period of their dietary tracking [35]. The results of the present study also showed that there was an overall relative stability in the number of times rice and stiff maize-meal porridge were recorded between 1995 to 2003 interceptions, although consumption of fruits and vegetables among this longitudinal group of South African children was very low compared to Chinese children.

Many cross-sectional studies conducted in Africa have reported that school children living in developing countries consume monotonous diets like adults and their meals are between 2 to 3 daily [9, 21, 71, 109, 111]. These monotonous diets contribute to :

- low micronutrient intakes,
- low energy intakes, and
- chronic diseases of lifestyle [11].

6.1.3 Comparison with other studies in developed countries

Important differences exist in the amount and types of food consumed by children/adults in underdeveloped/developed countries. This makes comparison difficult and perhaps even spurious. However, several food item intakes of these Bt20 urban black children were within the ranges of international results.

According to Anderson's study [101] on dietary patterns among adolescents in the West of Scotland, compared with a "healthy eating index", it was shown that less than one-third of the subjects ate a diet similar to that promoted by the local health education campaigns. The food items most frequently recorded by these children were chips, crisps, sweets, chocolate and soft drinks [101]. Similarly, the top listed food items above were among the individual food items recorded by the population in the present study.

A more recent study, the British National Survey of Health and Development, conducted a comparative analysis of nutrient and food intakes of four-year old children in 1950 and 1992. The results revealed that consumption of bread and vegetables were consumed frequently by these children in 1950, whereas, the same age group born in 1990s preferred, soft drinks and savoury snacks [94]. However, in contrast, a study by Inchley [100] on dietary trends among Scottish school children in the 1990s showed that there were improvements in the food intake of these children at this time, especially fruits and vegetables consumption which increased among girls but it was still below the dietary recommendations. Boys from lower socio-economic status consumed high-fat and high-sugar foods [100]. It was also reported that there was daily con-

sumption of chips, sausages, burgers and pies, and sweets and chocolate. The increase in consumption of these food items was noticeable both among boys and girls and an additional 10% consumed these items daily in 1998 compared with 1990 [100]. In the present study, there was stable consumption of sweets, crisps and chocolate among these children from 1995 to 2003, but apparently not a high consumption of fast foods eg chips, burgers, pies.

In a study by Bowman, 6212 children and adolescents were studied. In that report, 1720 children and adolescents ate fast food daily. These fast food consumers ate more total fat, more saturated fat, more total carbohydrate, more added sugars, more sugar-sweetened beverages, less fluid milk, and fewer fruits and non-starchy vegetables [88]. The present study's result also confirm the observed decrease in the consumption of milk and fruits as in Bowman's study.

A recent longitudinal study tracking the growth and nutrition among Parisian children revealed that frequency of consumption of snacks increased with age among the subjects examined. Forty percent of the children at 10 consumed snacks and this increased to 89% at the age of 16 years. Consumption of fat was high being 36–38% of total energy intake compared to the recommended 30-35% [97].

The DONALD Study on fifteen-year trends in energy and macronutrient intake among German children and adolescents showed that with age the energy and total food intake of these children increased 2.2-fold in girls and 1.8-fold in boys. The percentage of beverages in the total weight of food intake also increased with age from 36% to

45% in boys and from 36% to 47% in girls [96]. In contrast, the percentage of children who consumed miscellaneous food items did not increase with age in the present study. Between 53% to 92% of the children consumed these food items and the consumption was stable over the period of eight-years.

Brady [107], studied 110 African-American and Caucasian males and females aged 9.9 years and reported that 50% of the participants' diets came from discretionary fats and added sugar [107]. More than 90% of children from this longitudinal investigation consumed sugar, sweets, and tea but the mean consumption of oil was 83.6%. Both Brady's and the present study found a high percentage of children consuming food from sugars and fat and oils groups.

According to The US Department of Agriculture (USDA) findings, 90% of teenage girls and 70% of teenage boys do not meet calcium recomendation due to poor consumption of milk [156]. Similarly, Inchley [100] also reported the decrease in consumption of milk among the subjects examined, while Deheeger reported low calcium intake especially among girls in the group of children studied [97]. The present study also showed a decrease in consumption of milk from more than 90% in 1995 and 1999 to 69% in 2003 which was the lowest percentage over the 5 interceptions.

On the other hand, a study from the US showed that the intake of soft drinks had increased between 1965 to 1996. Regular soft drinks consumption increased 187% for adolescent males and 123% for adolescents females. In addition, children who consumed flavoured milk had higher total milk intakes and lower soft drink and fruit drink

intakes. The study also reported that there was an increase in consumption of sugar-sweetened beverages, sugar and sweets, and sweetened grains, cakes, cookies and pies [157]. In the present study the consumption of fruit juice intake increased significantly but that of sugar, carbonated beverages remained stable but there was a decrease in the intake of milk and milk produts over the 5 interceptions.

It is clear from the discussion that increased urbanization does introduce new foods as well as change the importance in consumption of others. From the variety of food items consumed by this urban black South African children it is evident that there has been a movement towards an increased importance of foods such as sugar, sweets and carbonated beverages also found in studies conducted in other developing countries. However, the traditional diet of maize-meal porridge still remains important for this group of children. Thus, although there is definitely a shift away from the prudent diet, the diet of these children has not reached that of the developed countries. South Africa is still in the process of a nutrition transition. It is quite disturbing to note the high ranking of energy dense foods (sugar, sweets etc) and the low ranking and limited varieties of fruits and vegetables.

6.1.4 METHODOLOGY CRITICISM

Selection of dietary survey methodology

One of the most difficult, time-consuming, and expensive components of research on the relationships among diet, health, and the nutritional status of individuals or groups is the measurement of food intake [121]. However, no method has been able to yield precise and accurate quantitative amounts of foods eaten in obtaining usual food in-

take of free living individuals [132]. The choice of dietary methodology used in the measurement of food intake dictates to some extent the results that could be achieved. Hence, several methodological remarks need to be made before drawing conclusions to this study:

1. Dietary intake is only an estimate.

2. Method of choice depends on the objectives of the study.

The food frequency-questionnaire met the objectives of this study. First and foremost, the semi-quantitative food frequency questionnaire designed to measure the common foods and usual intake of these children at baseline did not include new foods as they grew older. Hence, omissions of foods from the food list may result in underestimation [45]. However, it did allow for consistency throughout the study.

Another limitation of the methodology used in this study was the coding. Although the interviewers were trained in coding there are subtle differences in the food codes for some food items that makes coding difficult. For instance if the subject did not differentiate between "butter" or "margarine" one coder may use the code for "butter" while another may use that of "margarine". "Meat with fat" and "meat with fat trimmed" is another example. This is not the fault of the coder, interviewers should ensure that they collect data accurately, e.g. to ask about the type of "butter". As far as possible the coders used the same codes in this study but human error cannot be ruled out.

Overestimation does occur when the children are presented with lists of commonly eaten foods and inferred that they ate these foods more often while they did not [70]. Secondly, dietary assessment among children is difficult because it requires skills such

as event equalization, estimation of frequency and averaging which the children do not have. In this view, many errors arise in collecting data from children and the errors are as follows:

- Earlier collection of nutrition information data from the children relied solely and or partially on the parent's or guardian's power to recall [158].
- children may systematically distort information on their food intake to achieve a positive image from the interviewer [70].
- Inattentiveness may arise from the children because of too much time required for the whole interview [70]
- Subjects may be unable to recall or aggregate all eating patterns of a month or a year accurately [45].

The study design and dietary-assessment methodologies were identical for all the measurement of dietary patterns of Bt-20 children since the inception of the study in 1990 [134]. This allowed for consistency throughout. The validity and reproducibility of the food frequency questionnaire used among these urban black children have been demonstrated and this was thus the method of choice in Bt-20 because of the cost effectiveness and the ease of its application [45, 134, 117].

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary and Conclusion

The overall objectives of this study was to determine the variety and change in consumption of individual food items consumed by a true longitudinal group of urban black South African children at 5; 7; 9; 10 and 13 years of age.

Several major findings have emerged from this present study. Most importantly, a wide *variety* of individual food items was recorded by this longitudinal group of urban black South African children, (546 different foods). During the eight-year of nutrition interception, eleven food items were from miscellaneous food group, eight from fruits and vegetables food group, followed by seven from the meat and meat substitutes, six for fats and oils food group, five from grain/cereal group/breakfast cereal/porridges and other starches and three food items were recorded for the milk and milk substitutes.

There were *changes* in the importance and ranking of many of the individual food items recorded for these urban black children. Starting from grain/cereal group/breakfast cereal/porridges and other starches food group, most of these food items consumed in 1995 interception decreased remarkably by the year 2003. The highest differences were recorded for soft maize-meal porridge and samp and beans.

With regard to meat and meat substitutes, the dietary patterns of these children showed similar decreasing trends except for a slight increase in consumption of cheese and chicken. The most interesting food item in this group was peanut butter, a cheap source of protein, but its intake decreased suddenly in the 2003 interception.

The urban black children's food item intakes examined in this study did not follow healthy dietary patterns with regard to consumption of fruits and vegetables. In fact, a very alarming trend emerged with only eight fruits and vegetables being recorded. Only fruit juice intake increased remarkably in the year 2003 interception but consumption of others steadily decreased with the highest decrease in consumption being for cabbage.

Furthermore, the changes in consumption of the forty-one food items recorded was noticed within fats and oils food group. The children in this study consumed more ice cream in the year 2003 interception and consumption of the remaining food items from this food group decreased with the highest decrease in consumption of butter but this was probably not really just confusion of the fieldworkers.

Changes were also evident in the consumption of milk and milk products with the highest decrease recorded for full cream milk.

A relatively stable consumption of the miscellaneous food items were observed among the study population. Only the consumption of jelly decreased while coffee intake in-

creased.

This study has provided valuable, unique information on the variety, consumption and change in consumption over time of individual food items among a true longitudinal group of urban black South African children. In addition, it is the first comprehensive examination of individual food item intakes of a true longitudinal group of South African children.

Eating patterns change over time. Studies have been conducted in industrialized countries stating that it is important to study the longitudinal development of dietary intake itself and to determine the stability of this intake, but monitoring longitudinal dietary habits of the same children over a period of time, in particular with regard to individual food items, is severely limited in developing countries such as South Africa.

South Africa, a country with diverse cultures, is undergoing massive socio-economic and political changes, and an increasing social integration following the abolishment of the previous apartheid legislation [140]. Obviously diet too must have been affected. The country is in a state of nutritional transition and, if the nutritional status of South African children is to improve in the 21^{st} century basic knowledge is required of the actual food items the children have been, and are consuming, and the change in consumption of these individual food items during this transition. This is why it is important to be able to measure new foods over time and not to stick to the limited list of foods used at baseline.

7.2 Recommendations

The dietary patterns of this longitudinal group of urban black South African children is far from the recommended South African Food-Based Dietary Guidelines (FBDGs), which was developed with the aim of making evidence-based nutrition and lifestyle messages to the public accessible, understandable, generalizable, acceptable in a cross-cultural context and feasible. Thus, this study has provided useful insights to guide the governmental parastatals, nutrition scientists and other interested cooperate bodies in promoting successful nutrition intervention strategies that will lead to healthy dietary habits among children and adolescents.

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APPENDIX

A. CLEARANCE CERTIFICATE/PROTOCOL NUMBER

A. CLEARANCE CERTIFICATE/PROTOCOL NUMBER

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Pedro

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER 03-05-81**
PROJECT	Comparison of Individual Food Item Intakes of a True Longitudinal Group of South African Children at Five Interceptions Between
INVESTIGATORS	Mrs TM Pedro
DEPARTMENT	Paediatrics
DATE CONSIDERED	03-05-30
DECISION OF THE COMMITTEE*	Approved unconditionally

DATE 03-07-04

CHAIRPERSON .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr JM Mackeown
Dental Research Institute

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

B. DENTAL RESEARCH FOOD FREQUENCY QUESTIONNAIRE

(Based on Rowett Research Institute, Aberdeen, Scotland, for South African population)

FOR OFFICE USE ONLY

CHILD'S NAME AND SURNAME _____

BIRTH-TO-TWENTY-NUMBER _____

DATE OF BIRTH _____ AGE (YEAR AND MONTH) _____

SEX _____

ETHNIC GROUP _____

SURVEY VENUE _____ SURVEY DATE _____

INSTRUCTIONS

Please complete **both** Section A and B of the questionnaire

SECTION A

The following questions in **Section A** are about the foods you **USUALLY** eat during an average week. Please indicate the number of **days per week** that you eat each item on average. Ring the answer as in the examples:

If you eat the food everyday, ring 7	7	6	5	4	3	2	1	M	R
If you eat the food 3 days/week, ring 3	7	6	5	4	3	2	1	M	R
If you eat the food only monthly, ring M	7	6	5	4	3	2	1	M	R
If you never or rarely eat the food, ring R	7	6	5	4	3	2	1	M	R

where spaces are provided after a question please write your answer in the space.

GRAIN AND CEREAL GROUP

	No. days/week								
Bread	7	6	5	4	3	2	1	M	R
Provitas/cream crackers etc.	7	6	5	4	3	2	1	M	R

Do you mainly eat white, brown or wholewheat bread?_____

How many slices of bread do you have /day?_____

BREAKFAST CEREAL AND PORRIDGES

	No. days/week								
Cereal, (Rice, Krispies, Cornflakes)	7	6	5	4	3	2	1	M	R
Sugar coated cereals (Coco pops, Frosties)	7	6	5	4	3	2	1	M	R
W/wheat cereals (All Bran, Weetbix)	7	6	5	4	3	2	1	M	R
Porridge (Oats, Maltabella, Maize meal)	7	6	5	4	3	2	1	M	R
Muesli	7	6	5	4	3	2	1	M	R
Pronutro	7	6	5	4	3	2	1	M	R

OTHER STARCHES

	No. days/week								
Rice, pasta	7	6	5	4	3	2	1	M	R
Stiff maize meal - with amasi (sour milk)	7	6	5	4	3	2	1	M	R
- without amasi (sour milk)	7	6	5	4	3	2	1	M	R
Samp/mielie rice - with beans	7	6	5	4	3	2	1	M	R
- without beans	7	6	5	4	3	2	1	M	R

MEATS AND MEAT SUBSTITUTES

	No. days/week								
Red meat (beef, lamb, pork or mince)	7	6	5	4	3	2	1	M	R
Processed meat (bacon,sausages, polony)	7	6	5	4	3	2	1	M	R
Chicken	7	6	5	4	3	2	1	M	R
Fish (fresh or frozen)	7	6	5	4	3	2	1	M	R
Tinned fish (pilchards, sardines, tuna)	7	6	5	4	3	2	1	M	R
Eggs and egg dishes	7	6	5	4	3	2	1	M	R
Cheese, cheese spread and cheese dishes	7	6	5	4	3	2	1	M	R
Nuts, including peanut butter	7	6	5	4	3	2	1	M	R
Dried peas, beans, baked beans or legumes	7	6	5	4	3	2	1	M	R

VEGETABLES AND FRUITS

	No. days/week								
Green and/or yellow vegetables	7	6	5	4	3	2	1	M	R
Potatoes	7	6	5	4	3	2	1	M	R
Fresh fruit	7	6	5	4	3	2	1	M	R
Canned fruit	7	6	5	4	3	2	1	M	R
Dried fruit (raisins, prunes, dates)	7	6	5	4	3	2	1	M	R
fresh fruit juice (Liquid fruit juice Ceres)	7	6	5	4	3	2	1	M	R

Name some of the vegetables you have eaten this week

Do you eat your vegetables most frequently cooked or raw?

Do you mainly eat potatoes as boiled, baked in jacket, mashed, roasted or as chips?

What types of fresh fruit have you eaten this past week?

FATS AND OILS

	No. days/week								
Oil/butter/margarine	7	6	5	4	3	2	1	M	R
Salad dressing/mayonnaise	7	6	5	4	3	2	1	M	R
Cream	7	6	5	4	3	2	1	M	R

If you eat cream how many teaspoons would you have_____

	No. days/week								
Non dairy creamers (cremora)	7	6	5	4	3	2	1	M	R
Ice cream	7	6	5	4	3	2	1	M	R

If you eat ice-cream how much would you eat (in cups or tablespoons or cones)

_____

Please estimate, on average, the total amount of butter or margarine you have on your bread per day _____Tsp.

	No. days/week								
How often do you have fried food?	7	6	5	4	3	2	1	M	R

MILK AND MILK PRODUCTS

	No. days/week								
Milk	7	6	5	4	3	2	1	M	R
Yoghurt-plain	7	6	5	4	3	2	1	M	R
-flavoured	7	6	5	4	3	2	1	M	R
Milo/Nesquick/cocoa/Horlicks	7	6	5	4	3	2	1	M	R
Custard	7	6	5	4	3	2	1	M	R

What type/s of milk do you use?

full-cream _____

low-fat (2% fat) _____

skimmed _____

condensed _____

Please estimate, on average, how much milk you have per day, including that on cereal, in tea or coffee and milk drinks

_____ml or _____cups.

If you eat yogurt, how much would you usually eat at one time? (in tablespoons, cups or cartoon)

_____

MISCELLANEOUS

Please estimate how many teaspoons of sugar you have, in total, per day? ___tsp. (in tea/coffee/milk drinks, on cereal/porridge, added to vegetables)

	No. days/week								
Sweets (sucking /jelly type/fudge/toffee)	7	6	5	4	3	2	1	M	R
Chocolate/chocolate bars	7	6	5	4	3	2	1	M	R
Jam, syrup, honey	7	6	5	4	3	2	1	M	R
Jelly	7	6	5	4	3	2	1	M	R
Sweet biscuits,cakes, pastries, doughnuts	7	6	5	4	3	2	1	M	R
Tarts,scones,crumpets	7	6	5	4	3	2	1	M	R
Crisps	7	6	5	4	3	2	1	M	R
Popcorn (plain or candid)	7	6	5	4	3	2	1	M	R
Puddings (trifle, baked puddings etc.)	7	6	5	4	3	2	1	M	R
Cold-drinks (coke, Fanta etc.) or cordials									
- sweetened	7	6	5	4	3	2	1	M	R
- diet	7	6	5	4	3	2	1	M	R
Tea	7	6	5	4	3	2	1	M	R
Coffee	7	6	5	4	3	2	1	M	R
Spread (bovril,marmite, fish paste, sandwich)	7	6	5	4	3	2	1	M	R

ALCOHOL

	No. days/week								
Beer	7	6	5	4	3	2	1	M	R
Wine	7	6	5	4	3	2	1	M	R
Spirits (e.g. Whisky)	7	6	5	4	3	2	1	M	R

How much would you usually drink (e.g. 1 can beer/ 1 glass of wine)?

How many meals do you eat per day ie. Breakfast, lunch and/or dinner?

How many in-between meal snacks do you eat per day i.e. mid-morning, mid-afternoon and or late evening? (e.g. If your child has a sweet half an hour after a meal consider it 1 in between meal snack. If he/she has a fruit juice then an hour later has a sandwich consider that 2 in-between meal snacks).

SECTION B

Please indicate in **Section B** how many **portions** of the following food groups you **ate yesterday** by circling the appropriate number.

E.g. If you had **1 egg** for breakfast, **cheese** for lunch and **chicken** for dinner, ring 3; for 2. If he/she had **cereal** and **1 slice of toast** for breakfast, a sandwich for lunch **(2 slices of bread)** and **rice** for dinner, ring 5 for number 6.

		No. Portions yesterday									
1	Milk,yoghurt (1portion = 1cup/200ml)	1	2	3	4	5	6	7	8	9	10
2	Meat/fish/chicken/cheese/eggs/nuts/legumes	1	2	3	4	5	6	7	8	9	10
3	Fruit/fruit juice	1	2	3	4	5	6	7	8	9	10
4	Vegetables	1	2	3	4	5	6	7	8	9	10
5	Potatoes	1	2	3	4	5	6	7	8	9	10
6	Bread/cereal/porridge/rice/pasta/ maize meal/samp/mielie rice	1	2	3	4	5	6	7	8	9	10
7	Oil/butter/margarine/cream/non dairy creamers/ salad dressings (1 portion =1tsp)	1	2	3	4	5	6	7	8	9	10

Were these number of portions typical of what you would normally consume on an average day?

Yes _____ No _____

If you answered No, was the difference due to:

illness _____

a party _____

eating out _____

other reasons _____

C. COMPUTER CODING SHEET

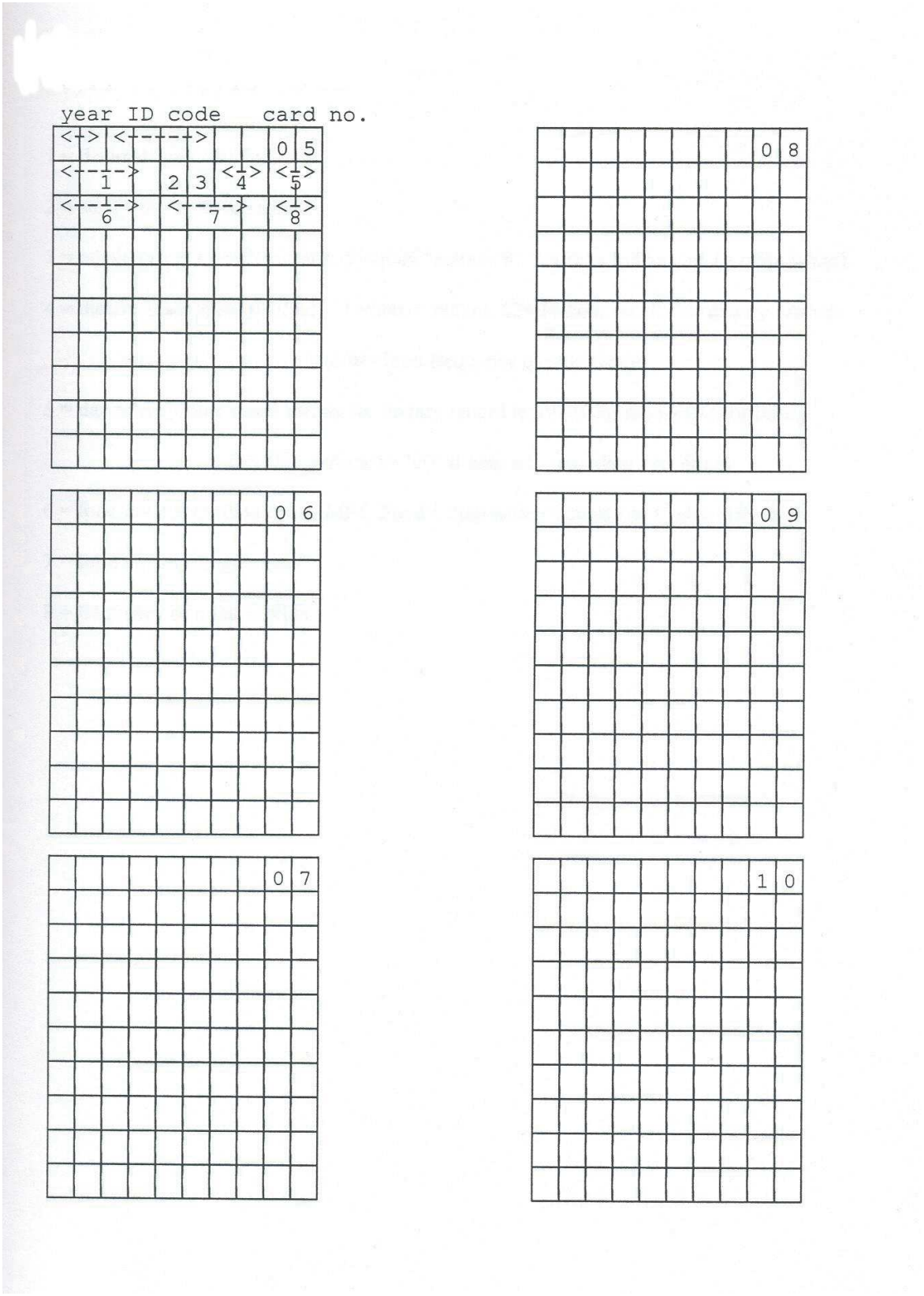


Fig. C.1: COMPUTER CODING SHEET USED FOR 1995, 1997, 1999, 2000, AND 2003 Bt-20 NUTRITION INTERCEPTIONS.