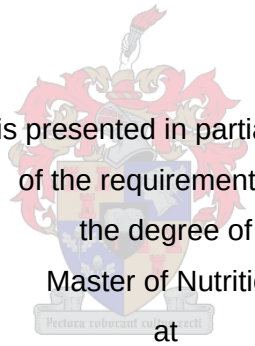
FRUIT AND VEGETABLE CONSUMPTION BY SOUTH AFRICAN CHILDREN, AGED 12 TO 108 MONTHS:

A secondary analysis of the National Food Consumption Survey data

Celeste Naudé



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DECLARATION OF AUTHENTICITY

I, Celeste Estelle Naudé, hereby declare that the work contained in this thesis is my own original work and that I have not previously, in its entirety or in part, submitted it at any university for a degree.

Signature: Date: 08-03-07

ABSTRACT

INTRODUCTION: Epidemiologic research strongly supports the importance of adequate fruit and vegetable intake for the promotion of human health and the prevention of chronic disease. Data suggest that fruit and vegetable consumption in children may protect against an array of childhood illnesses. Low fruit and vegetable intake has been recognized as a key contributor to micronutrient deficiencies in developing countries. Evidence indicates that fruit and vegetable consumption is inadequate in both developed and developing nations. A paucity of data on fruit and vegetable consumption exists in South Africa. Quantification of fruit and vegetable consumption is important for the worldwide drive to increase consumption and for strategy development to address inadequate consumption.

METHODS: A secondary analysis of the dietary intake data (24 hour recall questionnaire (24-H-RQ) and quantified food frequency questionnaire (QFFQ)), collected during the 1999 National Food Consumption Survey (NFCS) in 12 – 108 month old children in South Africa, was conducted to determine fruit and vegetable consumption (weighted sample size n = 2200). Consumption was related to anthropometric and socio-economic data from the NFCS database and household procurement was determined.

RESULTS: Mean daily consumption per capita of fruit and vegetables amounted to 110.1 grams (95% confidence interval (CI) = 103.8 to 116.4) [Standard Deviation (SD) 150] (n = 2200) (24-H-RQ) and 204.9 grams (CI = 196.9 to 212.9) [SD 188.2] (n = 2133) (QFFQ). These intakes were considerably lower than the theoretical-minimum-risk distributions established by the World Health Organization (WHO) and the American MyPyramid guidelines for fruit and vegetable consumption. Frequency of intake was low (2.16 times per day) (CI = 2.09 to 2.22) [SD 1.52] (n = 2071). Fruit was not eaten every day by all children (0.81 times) (CI = 0.77 to 0.85) [SD 0.96] (n = 2133) and vegetables were eaten approximately once daily (1.34 times) (CI = 1.3 to 1.38) [SD 0.92] (n = 2040). Consumption was low in all provinces and varied between provinces. Underweight (weight-for-age < -2 SD, NCHS 50th percentile) and wasted (weight-for-height < -2 SD, NCHS 50th percentile) children ate significantly less (Bonferroni $p<0.05$) fruit and vegetables. Children in more affluent households had significantly higher (Bonferroni $p<0.05$) consumption and frequency of intakes than children in poorer households. Children of more formally educated mothers had higher and more frequent intakes. Fruit and vegetables were primarily procured by purchase (90.2% of households).

CONCLUSIONS: The poor consumption and low frequency of fruit and vegetable consumption, in combination with the adverse socio-economic conditions and the household food and micronutrient insecurity in South Africa, calls for individual interventions. Interventions beyond the individual level are also fundamental and the broader food environment must support individuals in making healthful

food choices, across all income levels. International and national interventions to food policies should ensure that healthful foods are accessible and affordable to all individuals. Effective nutrition education aimed at improving fruit and vegetable intake should be continued and developed within the national, provincial and local health structures. This study supports and adds to the compelling body of evidence supporting the need for the development and implementation of effective programmes and policies aiming to increase the consumption of fruit and vegetables among children.

OPSOMMING

INLEIDING: Die belangrikheid van genoegsame inname van vrugte en groente vir die bevordering van menslike gesondheid en vir die voorkoming van kroniese siektes word deur sterk epidemiologiese navorsing ondersteun. Studies dui daarop dat vrugte en groente inname in kinders beskerming mag bied teen ‘n verskeidenheid kindersiektes. In ontwikkelende lande word lae vrugte en groente inname beskou as ‘n hoof bydraende faktor tot mikronutriënttekorte. Navorsing toon ‘n onvoldoende inname van vrugte en groente in ontwikkelde en ontwikkelende lande. Daar is tans ‘n gebrek aan navorsing oor vrugte en groente inname in Suid-Afrika. Kwantifisering van vrugte en groente inname is belangrik vir die wêreldwye veldtog vir die verbetering van vrugte en groente inname, asook vir die ontwikkeling van strategieë om onvoldoende inname aan te spreek.

METODES: ‘n Sekondêre analise van die dieetinname data (24 uur herroep vraelys (24-U-HV) en gekwantifiseerde voedselfrekwensie vraelys (GVFV)) van kinders tussen die ouderdomme van 12 en 108 maande, verkry tydens die 1999 *National Food Consumption Survey* (NFCS) in Suid-Afrika, om vrugte en groente inname te bepaal (geweegde steekproef n = 2200) was uitgevoer. Verwantskappe tussen hierdie inname en antropometriese en sosio-ekonomiese data, vanuit die NFCS databasis, is ondersoek en metodes van verkryging van vrugte en groente deur huishoudings is bepaal.

RESULTATE: Die gemiddelde daaglikse inname per kapita van vrugte en groente was 110.1 gram (95% vertroulikheidsinterval (VI) = 103.8 tot 116.4) [Standaardafwyking (SA) 150] (n = 2200) (24-U-HV) en 204.9 gram (VI = 196.9 tot 212.9) [SA 188.2] (n = 2133) (GVFV). Hierdie innames was baie laer as die teoretiese-minimum-risiko verspreidings bepaal deur die Wêreld Gesondheid Organsisasie (WGO), asook die Amerikaanse se *MyPyramid* riglyne vir vrugte en groente inname. Die gereeldheid van inname was laag (2.16 keer per day) (VI = 2.09 tot 2.22) [SA 1.52] (n = 2071). Alle kinders het nie elke dag vrugte geëet nie (0.81 keer per dag) (VI = 0.77 tot 0.85) [SA 0.96] (n = 2133) en groente is ongeveer een keer per dag ingeneem (1.34 keer) (VI 1.3 tot 1.38) [SA 0.92] (n = 2040). Inname was laag in alle provinsies en het gewissel tussen provinsies. Ondergewig (gewig-vir-ouderdom < -2 SA, *NCHS* 50ste persentiel) en uitgeteerde (gewig-vir-lengte < -2 SA, *NCHS* 50ste persentiel) kinders het beduidend minder (Bonferroni $p<0.05$) vrugte en groente geëet. Kinders uit meer gegoede huishoudings het beduidend hoër (Bonferroni $p<0.05$) innames gehad, asook meer gereelde innames, in vergelyking met kinders uit meer armoedige huishoudings. ‘n Hoër en meer gereelde inname is gevind in kinders wie se moeders meer formele skoolopvoeding ontvang het. Vrugte en groente is hoofsaaklik verkry deur aankope (90.2 % van huishoudings).

GEVOLGTREKKING: Die lae vrugte en groente inname en die lae frekwensie van inname tesame met die ongunstige sosio-ekonomiese toestande en die onvoldoende huishoudelike voedsel- en mikronutriëntsekuriteit in Suid-Afrika, benodig intervensie op die vlak van die individu. Intervensies

verder as die individuele vlak is ook noodsaaklik en die breër voedselomgewing moet individue vanuit alle inkomstegroepe ondersteun om gesonde voedselkeuses te kan maak. Internasionale en nasionale voedselbeleid behoort te verseker dat gesonde voedsels toeganklik en bekostigbaar vir alle individue is. Doeltreffende voedingsonderrig, gemik op die verbetering van vrugte en groente inname moet volhou en verder ontwikkel word binne nasionale, provinsiale en plaaslike gesondheidstrukture. Hierdie studie bevestig en versterk verder die oortuigende bewysde behoefte vir die ontwikkeling en uitvoering van effektiewe programme en beleide wat gemik is op die verbetering van vrugte en groente inname in kinders.

DEDICATION

To my parents, Stefan and Marié, for their consistent and unconditional love, for teaching me life's essential values, for encouraging, supporting and believing in me and for providing me with so many opportunities. To my siblings, Lynn, Angelique and Francois, for their love and care, for adding meaning and sharing the lighter side with me. To our Heavenly Father for His grace, peace and love that knows no boundaries. I am truly blessed.

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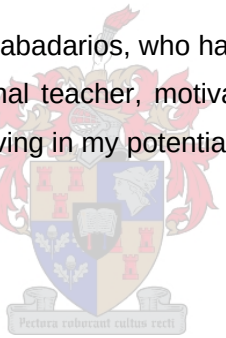
A word of special thanks goes to Prof Labadarios, who has encouraged me since I started in the field of nutrition. He has been an exceptional teacher, motivating and inspiring me to strive for greater heights and personal growth, and believing in my potential.



LIST OF DEFINITIONS

Z-score: The number of standard deviations from the reference population median [1]

Stunting: Less than minus two standard deviations (< -2 SD) height-for-age [2]

Underweight: Less than minus two standard deviations (< -2 SD) weight-for-age [2]

Overweight: Greater than plus two standard deviations (> +2 SD) weight-for-age or greater than plus two standard deviations (> +2 SD) weight-for-height [2]

Wasted: Less than minus two standard deviations (< -2 SD) weight-for-height [2]

Eaters: The children consuming fruit and vegetables

Head of household categories: Father-headed households, mother-headed households, grandfather-headed households, grandmother-headed households and other-headed households

Household income categories: No income (none), R100 to R500, R500 to R1000 and greater than R1000 per month

Education level of the mother categories: no formal education, primary school education, high school education and tertiary education

LIST OF ABBREVIATIONS

NFCS	National Food Consumption Survey
HAZ	Height-for-age Z-scores
WAZ	Weight-for-age Z-scores
WHZ	Weight-for-height Z-scores
24-H-RQ	24 hour recall questionnaire
QFFQ	Quantitative food frequency questionnaire
FFQ	Food frequency questionnaire
FPHIQ	Food procurement and household inventory questionnaire
kJ	kilojoules
WHO	World Health Organization
RSA	Republic of South Africa
EA	Enumerator area
USA	United States of America
SAVACG	South African Vitamin A Consultative Group
UNICEF	United Nations Children's Fund
FAO	Food and Agricultural Organization
DOH	Department of Health
IARC	International Agency for Research on Cancer
HPS	Health Promoting Schools
INP	Integrated Nutrition Program

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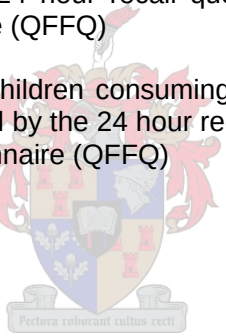

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CHAPTER 1: INTRODUCTION AND PROBLEM STATEMENT

1.1 CONSUMPTION OF FRUIT AND VEGETABLES IN RELATION TO HEALTH

It is commonly accepted that fruit and vegetables are essential components of a healthy diet. A multitude of substances, both nutrients and non-nutrients, are found in fruit and vegetables. Some of these substances are widespread, whilst others are characteristic of particular classes of fruit and vegetables.[3] These plant foods are good dietary sources of antioxidants, folate, vitamin C, manganese, beta carotene and potassium as well as vitamin E, pantothenic acid, biotin, choline, vitamin K, calcium, magnesium, non-haeme iron, chromium, molybdenum and selenium.[4] Generally, it can be said that eating a variety of fruit and vegetables ensures an adequate intake of most micronutrients, dietary fibres, as well as a multitude of essential non-nutrient phytochemical compounds.[5] These phytochemical compounds include a wealth of pigments, phenolic compounds, terpernoids and other natural antioxidants.[6] Research also supports the increased consumption of a wide variety of vegetables, specifically cruciferous, dark-green leafy and yellow-orange types, and a wide variety of fruit, particularly yellow-orange types.[7]

During the past decades many studies have investigated the relationship between fruit, vegetables and health.[3] In Europe, 4.4% of the total burden of disease has been attributed to low dietary intake of fruit and vegetables. For many diseases, a disease preventive potential of a diet high in fruit and vegetables has been established and adequate epidemiological data exists to support this preventive effect.[8, 9]

Epidemiologic research has started elucidating the role that foods play in the development of chronic diseases. Fruit and vegetable intake has been linked to decreased incidence and mortality from a variety of chronic diseases, including hypertension, diabetes, cardiovascular diseases, stroke, cancer and obesity.[10]

It has also been estimated that up to 70% of all cancer can be attributed to diet.[3] Over the past 20 years, studies have shown an inverse association between fruit and vegetable consumption and risk of cancer.[9] Consistent data supports the protective effect of greater fruit and vegetable consumption against cancers of the oral cavity, pharynx, oesophagus, stomach, pancreas, colon, lung and endometrium. Many of the nutrients/compounds found in fruit and vegetables have been shown or postulated to have anticarcinogenic actions. Substances present in fruit and vegetables that may play a role in cancer prevention include: dithiolthiones, isothiocyanates, indole-3-carbinol, allium compounds, isoflavones, protease inhibitors, saponins, phytosterols, inositol hexa-phosphate, vitamin C, D-limonene, lutein, folic acid, beta carotene, lycopene, selenium, vitamin E, flavonoids and dietary fibre.[3]

A great deal of the evidence on diet and cancer shows vegetable intake to be more strongly associated with a decreased risk than fruit consumption. For general recommendations and chronic disease, increasing vegetable consumption may be more important than increasing fruit consumption.[9]

In 2000, the South African National Burden of Disease Study found that cancers as a group accounted for 7.5 % of all deaths. Cancer was ranked as the fourth leading cause of death for all persons and the second leading cause of death among people older than 60 years. In males lung cancer accounted for 22.5 % of all cancer deaths followed by oesophageal cancer at 17.2 %. Amongst females, cervical cancer was the leading cause of cancer deaths at 17.9%, followed by breast cancer at 15.7 % and lung cancer at 10.9 %.[11]

There are a number of reviews on the protective role of fruit and vegetables in coronary heart disease. A publication in 2000 reported that taken together, findings from the ecological, case-control and prospective studies reviewed by these authors support a protective role for fruit and vegetables in coronary heart disease.[7]

A recent meta-analysis of cohort studies on fruit and vegetable consumption and stroke demonstrated that a higher intake of fruit and vegetables is associated with a reduced risk of stroke. Persons consuming 3 to 5 servings of fruit and vegetables per day had an 11 % reduction in the risk of stroke and persons consuming more than 5 servings had a 26 % reduction, in comparison to persons who consumed less than 3 servings. This meta-analysis found that both fruit and vegetables had a significant protective effect against stroke. The protective effects of fruit and vegetables on stroke have a strong biological basis. Fruit and vegetables are rich sources of folate, potassium, fibre and antioxidants, namely vitamin C, beta-carotene and flavonoids. Randomised trials have shown that increasing fruit and vegetable intake, with a subsequent rise in 24-h urinary potassium excretion, lowers blood pressure. Potassium supplementation has also been shown to result in a similar blood pressure reduction effect to that of fruit and vegetables. High blood pressure is a major cause of stroke and it is thought that the blood-pressure lowering effect of potassium could be one of the major mechanisms contributing to a reduced risk of stroke with an increase in fruit and vegetable consumption.[12]

Increasing trends in chronic disease development are well-documented and are a major contributing factor to the global burden of disease, in both the developed and developing world. Cardiovascular diseases remain the greatest cause of death in the world, with the prevalence of hypertension,

diabetes and obesity continuing to increase. A considerable amount of data shows that making a single dietary change and increasing fruit and vegetable intake, can contribute to stemming and/or reversing these trends.[10]

In the American population, poor intakes of fruit and vegetables have been linked to the metabolic syndrome. High fruit and vegetable intake has been related to decreased rates of premenopausal bone loss in women. In a dose-response relationship, greater consumption of fruit and vegetables has been associated with lower mortality rates.[9] It has also been observed that fruit and vegetable intake can aid in the displacement of foods high in saturated fats, salt or sugar in the diet, which when consumed in excess are known to promote diseases of lifestyle.[5]

Cataracts are one of the world's major causes of blindness. Considerable evidence suggests that the intakes of high levels of antioxidants (vitamin C, vitamin E and carotenoids) are associated with delayed development of cataracts. There is some epidemiologic evidence suggesting that the same beneficial relationship exists for fruits and vegetables.[7]

A number of epidemiologic studies have examined the role of fruit and vegetables in chronic obstructive pulmonary disease and the findings of these studies suggest that a high consumption of fruit and vegetables may enhance ventilatory function, thereby reducing the risk of chronic obstructive pulmonary disease.[7]

Diverticulosis is a common medical condition that has a clear link with aging. High-fibre diets which help to increase stool bulk and moisture and reduce gastrointestinal transit time, are known to protect against the development of diverticulosis. Fruit and vegetables are generally known to be high in insoluble fibre, especially cellulose. When examining the results of various studies that investigated the association between fruit and vegetable intake and diverticulosis, the evidence suggests that fruit and vegetables provide dietary fibre and the insoluble fibre, especially the cellulose in fruit and vegetables, may play an important role in preventing diverticulosis.[7]

Daviglus and colleagues published a study in 2005 showing that higher intakes of fruit and vegetables were associated with lower mean annual and cumulative medical aid charges and a saving of greater than $US 2000 in total costs per person in the highest category of consumption compared with those in the lowest.[13]

The precise mechanisms through which fruit and vegetables contribute to disease prevention have not been fully identified. However, it is thought that disease prevention may not be attributable to

single nutrients, but is generally attributed to the additive and synergistic effects of the phytochemicals and to the interaction of nutritive and non-nutritive compounds in these whole plant foods.[14, 15] In relation to cancer, evidence that the phytochemicals in fruit and vegetables assist in the detoxification of carcinogens, mutagens, drugs and toxins has been found. Studies suggest that the phytochemicals have a suppressing or blocking action, which results in a reduction of the risk for cancer. Identified mechanisms include neutralizing free radicals, inducing enzymes that inactivate carcinogens and inhibiting enzymes that activate carcinogens.[3]

Plant foods contain a large number of bioactive components with a variety of actions that are possibly related to chronic disease prevention. These constituents include different types of cell wall material and fibre that interact with the gut flora and biliary excretion to elicit local effects that maintain the gut mucosal lining as well as systemic effects, such as cholesterol-lowering, effects on insulin sensitivity and blood pressure reduction. Other components in plant foods have the ability to interact with receptors or response elements, resulting in changes to gene expression. Some responses may be categorised as chemical defences, for example, the reduction in radical-mediated damage and the induction of antioxidant enzymes. Other actions may be categorised as repair defences or as hormonal actions, such as the effects elicited by many compounds in soyabeans. A controlled dietary human intervention with fruit and vegetables, published in 2006, reports that fruit and vegetables may protect against chronic disease by eliciting short-term protective effects in periods after fruit and vegetable intake, so that frequent consumption may be necessary for continued protection. The short-term protective effects may include antioxidant or redox effects, alterations in sterol metabolism and xenobiotic-metabolizing enzyme induction. This study showed that fruit and vegetables have significant effects on plasma lipoprotein oxidation, erythrocyte peroxide metabolism, serum LDL-cholesterol and total cholesterol. None of these effects are related to any of the vitamins or minerals present in the fruit and vegetable intervention.[16]

1.1.1 Fruit and vegetable consumption and children's health

Dietary intake patterns in childhood and adolescence may predict the occurrence of adult cardiovascular disease and obesity and may also determine risk for adult diet-related cancers.[17] Epidemiologic data, particularly from migrant studies, suggest that childhood eating patterns are key determinants of adult risk of certain diet-related cancers.[18] There is also increasing evidence that fruit and vegetable consumption in children may protect against an array of childhood illnesses.[19] A study of over 20 000 children in six European countries, published in 2003, found an association between symptoms of respiratory disease and low fruit and vegetable consumption.[20]

A recent study by Moore *et al*, reported that higher consumption of fruit, vegetables and dairy in childhood may have beneficial effects on childhood blood pressure, with a stronger effect being shown for systolic than diastolic blood pressure. The combination of an increased intake of both dairy, fruit and vegetables were found to have the greatest blood pressure benefit. Foods are complex combinations of vitamins, minerals and other compounds and the mechanisms in this association remain unclear. However, diets high in fruit, vegetables and dairy products generally reflect healthier overall dietary patterns.[21]

1.1.2 Chronic disease and the nutrition transition

It is now recognized that chronic degenerative diseases are no longer restricted to the developed world and are emerging within the developing countries, at unparalleled rates. This is especially true in countries, like South Africa, undergoing the nutrition transition and the accompanying rapid economic development and related changes in diets and lifestyles.[22] Evidence suggests that among emerging populations in the nutrition transition, malnutrition in childhood is associated with an increased risk for the development of degenerative diseases. In nations undergoing the nutrition transition, stunting appears to be associated with overweight in later life.[23]

The nutrition transition is a progression of characteristic changes in nutrient intakes and dietary patterns related to social, cultural and economic changes during the demographic transition. In many developing countries, socio-economic status has a positive relationship with fat intake and risk of non-communicable diseases (NCD). Various publications have described the premise that fetal and childhood malnutrition may result in a higher susceptibility to the effects of overnutrition, when people are exposed to affluence in adulthood. Therefore, it can be said that in order to prevent NCD or to decrease the risk of development of NCD, it is necessary to prevent undernutrition in pregnant women and children and overnutrition in all stages of the lifecycle.[24]

1.1.3 Micronutrients and dietary diversity

In addition to the association between inadequate fruit and vegetable intake and chronic disease, low fruit and vegetable consumption has been recognized as a key contributor to micronutrient deficiencies in the developing world.[22] According to the Global Progress Report on Vitamin and Mineral Deficiency, issued by the Micronutrient Initiative and United Nations Children's Fund (UNICEF), moderate levels of vitamin and mineral deficiency are common in nearly all countries. This report recognizes the problem of diet as being central to this micronutrient issue.[25]

In the developing world, poor dietary diversity is a major problem and diets are based largely on starchy staple foods and often include little or no animal products and only seasonal fruit and

vegetables. Small amounts of more nutrient-rich foods are added to these staples, according to affordability and availability, but this addition is insufficient in terms of micronutrient needs. The most fundamental approach to managing this problem is seen to be the improvement and diversification of the diets in these nations, which in essence is dependent on increasing incomes. Consequently, efforts to reduce these deficiencies have focused on supplementation and fortification, due to their more immediate nature.[25, 26]

1.2 FRUIT AND VEGETABLE CONSUMPTION

Despite the mounting research that supports and emphasizes the protective effect of fruit and vegetables in human health, recent evidence indicates that consumption of fruit and vegetables is clearly inadequate in both the developed and developing world.[22]

Nationally representative data on fruit and vegetable intake in 21 countries, mostly from the developed world, indicate that average consumption reaches the World Health Organization (WHO)/Food and Agricultural Organization (FAO) minimum recommended level of 400 grams per capita per day (146 kg per capita per year) in only 3 countries, namely Israel, Italy and Spain. A WHO survey assessed the patterns of fruit and vegetable consumption in sub-Saharan African countries. The levels of fruit and vegetable consumption documented in sub-Saharan African countries ranged from 27 kg to 114 kg per capita per year, which is well below the WHO/FAO recommended minimum of 146 kg per capita per year. These levels are, however, comparable to the estimates by the International Agency for Research on Cancer (IARC) using FAO data. The IARC estimates of fruit and vegetable consumption ranged from 36 kg to 80 kg per capita per year in different regions of sub-Saharan Africa.[22]

While the availability of fruit and vegetables in the lowest-income countries is only half of the recommended intakes, at approximately 86 kg per capita per year, the supply in developed nations exceeds the required amounts, at approximately 223 kg per capita per year. The difference in consumption of fruit and vegetables, however, appears to be far greater than the difference in availability, if judged by the information available on consumption levels.[22]

Various regional studies which include fruit and vegetable consumption in children in South Africa have been published. In 1994, a study conducted in 3 to 6 year-old African children in the Cape Peninsula reported that the children's diet was deficient in fruit and vegetable intake when compared with the recommendations of the Department of Health Services and Welfare.[27] Qualitative dietary

data reflected infrequent intake of fruits and vegetables and of foods of animal origin in 4 to 24 month-old children in Kwazulu-Natal in 1999.[28] Similarly, in Limpopo, a prospective cohort study conducted in children at ages 1 and 3 years, found that the general nutrient intakes of the children were low, which was consistent with other findings in black South African preschool children. The children's diet was of poor quality, consisting mainly of carbohydrate foods, with a low consumption of dairy products and fruit and vegetables. This was found to be consistent with previous studies in this province.[29]

A recent publication, which was based on an analysis of the NFCS data, determined which foods contribute most to energy, macronutrient and micronutrient intakes of South African children aged 12 to 108 months. Additionally, the study evaluated the dietary content according to the Food Based Dietary Guidelines in children older than 7 years. It was found that the guidelines not being met were those aimed at increasing fruit and vegetable intake, improving the variety of foods eaten, increasing legume intake and eating more animal foods. Overall the contribution of fruit and vegetables to all nutrients in the diet were found to be low as well as the per capita portions, which fell short of the WHO/FAO[30] recommended amount of 400 grams per day.[31]

The WHO Global Burden of Disease project in the 1990's provided estimates of the numbers of deaths due to major diseases, and of the amounts of "disability-adjusted" loss of healthy life as a result of those diseases, for various regions of the world. Following this, the 2004 WHO Comparative Quantification of Health Risks was aimed at estimating the amounts of death and disability due to the main avoidable causes of those diseases.[32]

In the 2004 WHO Comparative Quantification of Health Risks, low fruit and vegetable consumption was identified and reviewed as a major risk factor contributing to the global and regional burden of disease. This analysis assessed the levels of mean dietary intakes of fruit and vegetables (excluding potatoes), calculated in grams per day. The theoretical-minimum-risk distribution for fruit and vegetable intake was estimated to be 330 grams per day in children aged 0 - 4 years, 480 grams in children aged 5 - 14 years and 600 grams/day in adults. The effect of fruit and vegetable intake in preventing cerebrovascular disease, ischemic heart disease and cancers of the lung, oesophagus, stomach, colon and rectum, was estimated. The selection of diseases was based on previous reviews of the literature, which imply a protective effect of fruit and vegetables for stroke, ischemic heart disease and cancers of the lung and gastrointestinal tract.[33]

The Comparative Risk Assessment stated that the deficient intake of fruit and vegetables makes an important contribution to the global disease burden. It was estimated that increasing individual intake

of fruit and vegetables up to the theoretical-minimum-risk distribution could potentially reduce the global burden of disease for ischemic heart disease and ischemic stroke by approximately 31% and 19% respectively. The possible reduction in disease attributable to an increase in fruit and vegetable consumption was 19% in stomach cancer and 20% in oesophageal cancer. The total worldwide mortality attributable to insufficient fruit and vegetable intake is estimated to 2.726 million deaths or 26.662 million disability-adjusted life years (DALYs) per year. In the 2004 WHO Comparative Quantification of Health Risks, South Africa, grouped with other African countries, was found to be among the regions with the lowest intakes of fruit and vegetables. Intakes varied by age, and children and the elderly were found to have lower intakes than middle-aged adults.[33]

Further reports documenting the effects of inadequate intakes of fruit and vegetables on human health are available. Insufficient consumption of fruit and vegetables was among the risk factors documented as contributing to the global NCD burden in the WHO World Health Report in 2002.[8] According to data presented in the 2003 World Health Report, poor fruit and vegetable intake is among the top 10 risk factors contributing to attributable mortality.[5] The WHO ranks low fruit and vegetable consumption as the sixth main risk factor for mortality globally.[22]

A recently published report of a joint United Nations FAO/WHO Expert Consultation of Diet, Nutrition, and the Prevention of Chronic Disease recommends the consumption of a minimum of 400 grams of fruit and vegetables per day (excluding starch tubers) for the prevention of chronic disease.[10] Many countries have adopted this recommendation and several experts and organisations include it in their guidelines. Based on this recommendation, the United States of America (USA) initiated the well-known message of '5-a-day' and this has spread to several other countries. [8] It is now recognized that new recommendations for fruit and vegetable consumption may be greater than this well-known five servings per day for everyone older than 3 years.[14]

1.3 THE SOUTH AFRICAN NATIONAL FOOD CONSUMPTION SURVEY (NFCS)

Following findings in a national survey on the nutritional status of pre-school children in South Africa in 1994, the Department of Health (DOH) commissioned the NFCS in 1999. The main aim of the NFCS was to quantitatively evaluate the nutrient intakes and anthropometric status of children between the ages of 12 - 108 months, as well as to investigate factors affecting their dietary intake.[34]

The key findings from the NFCS revealed that nationally, nearly one in five children were stunted and one in 10 children were underweight. Additionally, in children aged 1 - 3 years, 13% had an energy

intake of less than half their daily energy needs and 26% consumed less than two-thirds of their energy requirement. The intakes of the following nutrients were found to be below two-thirds of the Recommended Dietary Allowances in South African children as a whole: energy, calcium, iron, zinc, selenium, vitamins A, D, C, E, riboflavin, niacin, vitamin B6 and folic acid. More than half (52%) of households experienced hunger, 23% were at risk of hunger and only 25% of households were deemed to be food secure.[34]

Food security is defined as access by all people at all times to enough food for an active healthy life.[35] When considering factors that impact on food consumption, household food security has been recognized as being an important factor. Direct indicators of food security include food procurement patterns and food, energy and nutrient intake. Household food procurement and household food inventories can therefore be used as direct indicators of household food security.[34] The NFCS results therefore support the presence of food insecurity at the household level in South Africa. Household food insecurity was found to be high in the lower income households due to the low number of food items found and consumed by children in these households, as determined by the food inventory and the 24HR, respectively.[34] The top six food items foods found in lower income households in South Africa (maize, sugar, tea, whole milk, brown bread and hard margarine) by the NFCS are largely energy-dense and nutrient poor, which is in line with the points mentioned previously regarding restricted food choice and income.[34]

Additionally, the NFCS demonstrated that a very significant percentage of the country's population exist under adverse socio-economic conditions and socio-economic upliftment has been recognized as essential for the sustainable decrease of micronutrient deficiencies and general undernutrition.[34]

The NFCS provided an assessment of the diet and dietary practices of South African children for the first time, and is seen as a landmark project by the DOH in terms of providing health policy-makers with relevant and useful information.[34]

1.4 DETERMINANTS OF FRUIT AND VEGETABLE CONSUMPTION

Dietary behaviour, as with all human behaviour, is shaped within an ecological milieu, which includes environmental, social and cultural factors as well as personal preferences. Food supply is influenced by economic, agricultural and political factors and impacts on food availability and cost, which in turn influences individual food choices.[36]

Various determinants of fruit and vegetable consumption have been recognized and these are known to influence households and individuals in different ways. Identified determinants of fruit and vegetable consumption include household income, prices and availability of fruit and vegetables relative to other prices, household members' preferences, the cost to the household and feasibility of fruit and vegetable production and the decision-making power of the women relative to men in the household.[22] According to the literature, predictors of low fruit and vegetable intake include low income, poor nutrition knowledge, low level of education, living in an underprivileged neighbourhood and low socio-economic status.[37] Individuals of high socio-economic status tend to follow a diet that is more in line with dietary guidelines for health in comparison with individuals of low socio-economic status. Studies repeatedly report that people of low socio-economic status have nutrient intakes and dietary patterns that increase the risk of diet-related disease and overall health.[38]

1.4.1 Determinants of fruit and vegetable consumption in children

A recent review of determinants of fruit and vegetable consumption among children and adolescents found that gender, age, socio-economic position, preferences, parental intake and home availability and accessibility of fruit and vegetables, were the determinants supported by the strongest evidence.[39] Socio-economic position, preferences, home availability and accessibility of fruit and vegetables, and parental intake were all positively associated with children and adolescents' fruit and vegetable consumption. A convincing positive link was also found between nutritional knowledge and shared family meals and fruit and vegetable intake by children and adolescents. The review identified very few studies conducted in developing countries, with no African studies being included.[39] It would be expected that the identified determinants would have different levels of effect in a developing setting in comparison to a developed setting, due to the obvious overall social, economic, agricultural and political differences.

1.4.2 Conceptual framework of determinants of fruit and vegetable consumption in children

The Pro Children Project is an international study involving nine European countries. It aims to both assess fruit and vegetable consumption among schoolchildren and their parents and to positively influence determinants of fruit and vegetable consumption by children. Different behavioural theories and the other data[39] were used to develop a conceptual framework (Figure 1.1) that can be applied to children's fruit and vegetable consumption and which considers both individual and environmental determinants. This framework is one of the most comprehensive models employed as part of research on fruit and vegetable intake in children and adolescents. The review identified a number of areas within this framework where research is lacking or is very sparse. These areas include amongst others, studies pertaining to the influences of national level factors, analyses of personal

factors, good research on the influence of the family setting and studies specifically analysing fruit and vegetable consumption. Half of the included papers were based on the USA population and there is a clear shortage of knowledge about determinants of fruit and vegetable consumption among other parts of the world.[39]

Results from the adult South African Food-Based Dietary Guidelines Consumer Study, conducted in the Western Cape and Kwazulu-Natal[40] identified affordability, availability and household taste preferences as barriers to fruit and vegetable intake. Fruit consumption was found to be strongly linked to availability and highly dependent on seasonal fluctuations. It was stated that most resistance to fruit and vegetable consumption was found in children and also in men, in some cases. These restricting factors are similar to those discussed previously and found in studies elsewhere.[41, 42, 43, 44]

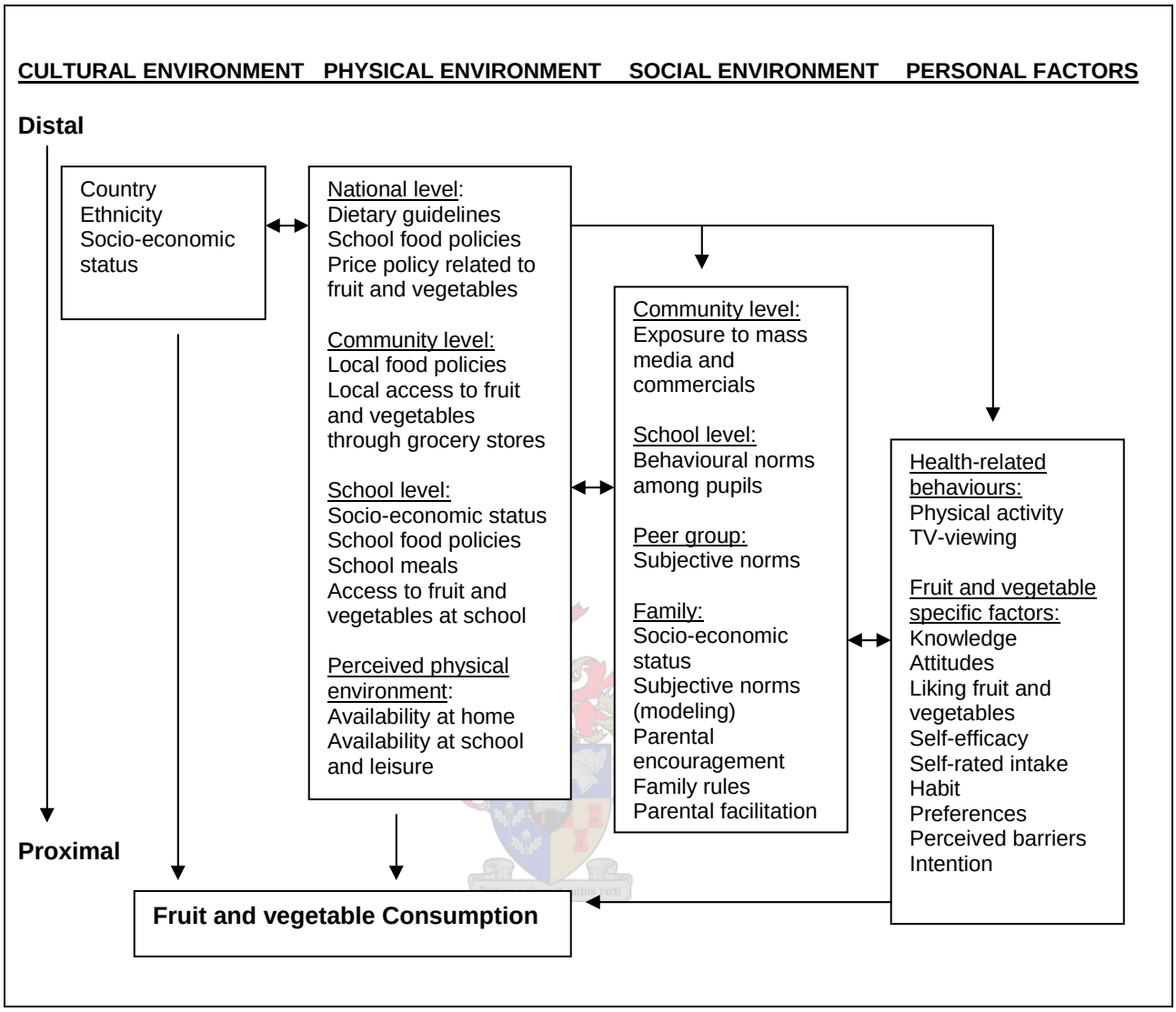

Figure 1.1: Conceptual framework applied to children's fruit and vegetable consumption: the Pro Children Project[39]

1.5 DEFINITIONS OF FRUIT AND VEGETABLES

In order to quantify fruit and vegetable consumption, it is important that the definitions of these plants are clear. The culinary definitions are commonly preferred despite the fact that the botanical definitions are more accurate. Aside from these definitions, the classification of fruit and vegetables should also relate to the health advantages and nutritional qualities of these foods. From a nutritional point of view, fruit and vegetables can be described as foods low in energy, comparatively rich in micronutrients, phytochemicals and other bioactive compounds as well as being good sources of dietary fibre.[8]

Certain groups of plant-based foods are not usually regarded as vegetables in most classifications, for example, herbs, spices and plant products used to make tea and coffee. These are usually classified under specific food groups other than vegetables. Similarly, foods derived from fruit and vegetables (e.g. jams, jellies) that may not retain the nutritive value of the original food, are classified into other groups such as 'sugars' or 'sweets'. Among main groups of plant-based foods, cereals are a group that are clearly identified as being different from fruit and vegetables, as they contain approximately 70% starch in weight. They serve as the starchy staple foods in most diets and contribute to a considerable part of energy intake in many areas globally. Wholegrain cereals are also an important source of dietary fibre.[8]

The inclusion of tubers, potatoes, legumes or pulses as vegetables is a more controversial issue. Potatoes and tubers as a group include yams, sweet potatoes, cassava or manioc and taro. The starch content of these foods varies between 12 and 50%. Pulses are the fruits and seeds of various leguminous plants, including those that have reached maturity and dried (beans or legumes) as well as immature pulses such as fresh peas. Dry legumes, like vegetables are a good source of fibre and various bioactive compounds, but are also regarded as the most valuable plant source of protein. Many dietary guidelines put potatoes in the cereals group as a starchy food, while on the other hand, potatoes are often considered to be vegetables. Some dietary guidelines overtly exclude potatoes from the recommendation to increase vegetable intake. Most often, legumes are also included in the vegetables group; however, dry beans are sometimes placed with meat and fish in the protein-rich food group.[8]

There is less deliberation about the classification of fruit, although the inclusion of nuts is a contentious issue. Nuts are dried fruits often enclosed in hard shells. They are energy-dense, with most of the energy coming from fat and they are important sources of unsaturated oils and protein, which may explain the reason for their inclusion in the pulses group at times. Like fruits, nuts are

high in bioactive compounds, including vitamins and minerals and the same applies for other high-energy botanical fruits such as olives and avocados. Fruit juices made from 100% pure juice can provide most of the micronutrients present in the original fruit, but fibre is lost and in some instances sugar is added. Many products branded as “fruit drinks’ contain only small quantities of the original fruit juice. In canned, frozen and dried fruit and vegetables, most of the properties of the original produce are generally preserved.[8]

1.6 DIETARY ASSESSMENT METHODS FOR FRUIT AND VEGETABLE CONSUMPTION

Certain dietary assessment methodologies are designed to measure the intakes of groups or households, for example, food procurement methods, household inventory. Other methods are designed to measure the dietary intake of individuals, for example, 24-H-RQ, food frequency questionnaire (FFQ), a diet history and weighed and estimated food records.[34]

The instruments used most often to estimate fruit and vegetable intake, as for many other foods, are the 24-H-RQ and the FFQ. Each method has unique elements with advantages and disadvantages depending on the purpose of the study. The 24-H-RQ method is suitable for measuring current intakes in groups of subjects. It is therefore appropriate to assess the group mean of fruit and vegetable intake, assuming that there is a well-balanced distribution of 24-H-RQ by weekdays and season and that the sample is representative. The 24-H-RQ does not afford reliable estimates of the usual intake, which reflect day-to-day variations, unless the recall is repeated in the same subject.[8] The mean of a sample of 1-day intakes from a population can be used to estimate the population’s mean usual daily intake.[14]

The FFQ when used in this context has ease of application and good flexibility. The quality of estimates provided is dependent on whether fruit and vegetables are expressed as groups or single foods in the questionnaire and on the number of items included in the questionnaire. Specification is thus an important element in measuring fruit and vegetable intake. If questionnaires provide a detailed list of fruit and vegetable consumption and specified quantities for each food item, quantitative estimates can be provided.[8]

1.6.1 Determinants and related factors of measuring fruit and vegetable consumption

1.6.1.1 Composite foods

Composite foods refer to manufactured foods and recipes that include fruit or vegetables as their components. The issue of composite foods and mixed dishes must therefore be mentioned in this context. The majority of dietary guidelines refer to fruit and vegetables as single foods and most studies report fruit and vegetable consumption as distinct portions only. The importance of including composite foods and mixed dishes is largely dependent on dietary patterns and the way in which fruit and vegetables are generally consumed in the specific population. In general terms, underestimation caused by the exclusion of composite foods seems to have a greater influence on vegetables in food diaries and 24-H-RQ and may be higher than the anticipated underestimation in FFQs. It seems that the inclusion of clear references to composite vegetable dishes in FFQs increases the validity of the FFQ. If composite foods are based mainly on fruit or vegetables and if fruit and/or vegetables account for at least 75% of the total weight of the food, it seems sensible to consider this food when quantifying intake.[8]

1.6.1.2 Frequency of consumption

Frequency of consumption refers to the number of times a specific food or food group is eaten over a defined period of time. Some FFQs collect only this information and it is then used to rank individuals according to their intake. In order to quantify fruit and vegetable intake, it is necessary that frequency of consumption be combined with a quantitative estimate of intake. The amount of detail with which fruit and vegetables are listed appears to be important and when comparing instruments that consist of a short list of foods with instruments that include a moderate number of fruit and vegetables, the latter having superior validity. Greater measurement quality is also evident in instruments that include questions on portion sizes and on the intake of mixed vegetable dishes.[8]

1.6.1.3 Portion size

Portion size remains an important issue in the process of attaining valid and reliable estimates of food and nutrient intake in humans. The matter of memory recall remains a central concern here and it is established that recalling and reporting the amount of food eaten is a difficult cognitive task. It is necessary that a wide variety of weights, dimensions and volumes be relayed, with an extensive range of shapes and units. Foods that are commonly purchased or eaten in defined units, such as many fruits, are generally reported with more ease than foods with irregular shapes. Many aids are used to assist the estimation of portion size and include food models, pictures and household measures. It has been shown that common household measures tend to overestimate quantities. It is

widely accepted however, that the accuracy of reporting depends fundamentally on the training of the interviewer and on the respondents.[8]

Usually, vegetable portions are defined by referring to household measures and fruit portions are defined in terms of single items of fruit, according to their size. Distinction between raw and cooked vegetables is also commonly applied in these quantifications. On a global level, the household measure used most often is a cup, which is equivalent to a volume of 250ml. For vegetable portions, a volume of 125ml of cooked or chopped vegetables or 250ml of raw leafy vegetables amounts to approximately an 80 gram portion. In terms of fruit, the edible component of one whole medium-sized fruit or two smaller-sized fruits amount to more or less an 80 gram portion. For very small and very large fruits and fruit juices, some changes need to be made to fit the approximate scale.[8]

The assumption that a standard portion weighs approximately 80 grams seems appropriate on average. However, it is said that actual portions consumed tend to be greater than 80 grams for fruit and less than 80 grams for vegetables. Actual portion size naturally is extensively variable between individuals of the same country and across countries. When a variety of both fruit and vegetables is eaten, the average intake quantity of 80 grams per portion becomes more realistic.[8]

1.7 NUTRITION AND HEALTH OF CHILDREN

According to the Medical Research Council Initial Burden of Disease Estimates, published in 2003, HIV/AIDS is the leading cause of death amongst young children. Low birth weight, diarrhoeal diseases, lower respiratory infections and protein-energy malnutrition follow and account for approximately 30% of the childhood deaths, and a significant number of these deaths are preventable.[45] The WHO defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.[46] A primary factor contributing to this state of health is good nutrition, which is a central factor in preventable deaths. The importance of nutrition in the prevention of disease as well as in growth and development cannot be disputed.

Energy-dense and nutrient-dense foods are especially critical for infants and young children due to their growth needs and their ongoing physical and mental development. Dietary diversity has been linked to improved nutritional status in young children, suggesting that variety may reflect an increased likelihood of meeting daily energy and nutrient needs as well as a higher dietary quality. Dietary diversity has also been shown to be strongly linked to household socio-economic status and the association between child nutrition and socio-economic status is a well documented one.[26]

Therefore, children need to consume a good variety of foods, which supply adequate amounts of energy, macronutrients and micronutrients, according to the body's needs at the specific age. Due to the rapid growth and development occurring in their bodies, children need more nutritious food in proportion to their weight than adults. Energy from the diet should be adequate to ensure optimal growth and to spare protein from being used as energy, but should not be excessive so as to promote the development of overweight and obesity. Energy and protein requirements for healthy, developing children vary according to physical activity level and age and macronutrient and micronutrient needs increase with age.[4]

The Dietary Reference Intakes (DRIs) are based on current knowledge of energy (Table 1.1) and nutrient intakes for optimal health and preventing disease.[47] The children included in the NFCS were between the ages of 1 and 8.9 years.

Table 1.1: Dietary Reference Intakes (DRIs) for energy for children aged 12 - 108 months

Gender	Age (years)	Estimated Energy Requirement (kJ)
Male	1 - 2	4393 (1046 kcal)
	3 - 8	7316(1742 kcal)
Female	1 - 2	4166 (992 kcal)
	3 - 8	6896 (1642 kcal)

Source: From reference[47]

1.7.1 Fruit and vegetable recommendations in children

The recommendations for children regarding the consumption of fruit and vegetables are variable and different guidelines exist. In the USA, the most recent guidelines, issued by USA Department of Agriculture's (USDA) food guide, are called MyPyramid. These food guides are intended to meet the nutritional requirements of almost every person, so they are designed to meet the Recommended Dietary Allowances (RDA) or Adequate Intake Levels, when no RDA is available. MyPyramid presents (Table 1.2) a set of recommended amounts of foods to consume, from the basic food groups to meet nutrient needs for each of 12 energy levels (DRIs) between 1000 kcal and 3200 kcal, assuming a sedentary activity level.[14, 48]

Table 1.2: Daily recommendations for fruit and vegetables from the United States of America MyPyramid Guidelines, using the DRI estimated energy recommendations per age group, for a sedentary activity level

Age (years)	Fruit	Vegetables	Total Fruit and Vegetables	Total Fruit and Vegetables (grams)
	Daily recommendation	Daily recommendation	Daily recommendation	Daily recommendation*
2 - 3	1 cup	1 cup	2 cups	320 grams
4 – 8	1 to 1½ cups	1½ cups	2½ to 3 cups	400 to 480 grams

* Assuming ½ cup equals 80 grams
Source: From reference[48]

In a recent publication it was found that most Americans eat much less than the recommended amounts of fruit and vegetables. The study found that assuming a sedentary activity level and two servings per cup, the percentages of the subpopulations meeting the MyPyramid guidelines (Table 1.2) for fruit and vegetables ranged from a low of 0.7% ±0.4% in 14-18 year old boys, to a high of 48% ±4% in children aged 2-3 years. Seventeen percent of 51-70 year old women met their fruit and vegetable requirements, and all other sex-age groups had fewer than 11% meeting their requirements.[14]

It is interesting to note that the MyPyramid guidelines for fruit and vegetables, in terms of quantities, are similar to the theoretical-minimum-risk distribution for fruit and vegetable intake from the 2004 WHO Comparative Quantification of Health Risks (330 grams per day in children aged 0 - 4 years, 480 grams per day in children aged 5 - 14 years).[33]

1.7.2 Eating behaviour in children

Due to the fact that dietary behaviours are developed early in life, the principles of a prudent diet should be promoted among children in developing countries.[24] More specifically, research has shown that the behaviour of eating plenty of fruit and vegetables during childhood is a significant positive predictor of fruit and vegetable intake among adults.[18] The protective factors in the diet, for example phyotchemicals and antioxidants, should guide recommendations and the formulation of nutrient requirements.[24] Ultimately, society must provide the structure and means for children to develop healthy and protective eating habits that promote good health into adulthood.[15]

In the transition from childhood to young adulthood, substantial changes occur in food group consumption patterns, with a general decrease in the quality of the diet. Research suggests that the promotion of a healthy daily eating pattern, consisting of all the major food groups, is needed from as early as 10 years of age and continuing into young adulthood.[49] Children and adolescents are seen

as particularly at risk of poor fruit and vegetable consumption due to their often erratic eating behaviour, including snacking on energy-dense foods instead of fruit and vegetables.[19]

1.7.3 Pesticide exposure

Pesticide residues in foods, including fruit and vegetables, may cause health problems, depending on the toxicity of the pesticide and the quantity consumed. For this reason, regulation of pesticide use is important and ongoing monitoring of pesticide levels in foods takes place in many countries, including South Africa. The Department of Agriculture, in cooperation with the Department of Health, governs this process in South Africa.[50]

However, monitoring and regulation studies in some countries have revealed areas of concern related to high residues in specific foods, for example dieldrin in root vegetables.[51] This highlights the importance of the monitoring process in order to minimise this type of exposure, especially amongst children.

1.8 MOTIVATION FOR THE STUDY

Measuring dietary intake accurately is a challenging task and this is well-known and accepted in the field of epidemiology. Nonetheless, valid measures of fruit and vegetable intake are imperative for public health programs and research, as well as for nutritional research for linking health outcomes with consumption. Ideally, these measures should give valid estimates at the individual level, providing absolute values of actual intake.[8]

At the end of 2005 the Commission of the European Communities and the USA Food and Nutrition Board, Institute of Medicine, National Academies of Science, released reports describing the ever-increasing problems of obesity and the associated chronic disease. The European report calls for concrete suggestions for promoting the health of the population, including, but not limited to, improving the availability and affordability of fruit and vegetables, nutrition education and self-regulation in the food and advertising industry. The USA report identifies advertising and marketing campaigns as offenders in the growing problems of obesity and chronic disease, and challenges the industry to focus on and promote the health and diets of children and young people.[15]

The South African DOH Integrated Nutrition Program (INP) has eight identified focus areas and the most recent objectives and targets of these focus areas were set by the DOH in September 2002. Micronutrient malnutrition control and nutritional promotion, education and advocacy are two of these

focus areas. Strategies identified in terms of the management of micronutrient malnutrition include dietary diversification, nutrition promotion, education and advocacy and supporting and promoting agricultural interventions to increase the availability of micronutrient rich foods.[52] Adequate fruit and vegetable intake is therefore highly relevant in the context of both the INP and the general nutritional health of the South African population.

Epidemiologic research strongly supports the importance of a high fruit and vegetable intake for the promotion of human health and the prevention of chronic disease.[3, 53, 54] It has been shown that patterns of fruit and vegetable intake in childhood track into adolescence.[39] Additionally, eating habits and food preferences manifested in childhood and adolescence tend to continue through to adulthood. Thus, the promotion of adequate fruit and vegetable intake by children and adolescents is a significant public health issue. In order to improve health-related behaviours, the most important determinants of these behaviours must be identified and interventions must be tailored accordingly.[39]

South African data on fruit and vegetable consumption are scantily available, but is of a regional and ad hoc nature.[40] In a paper by Love *et al* in 2001, the following trends and conclusions were reported. Black rural inhabitants of South Africa eat some fruits when available and usually these are consumed only by women and children. Vegetables are eaten as part of two main daily meals in the form of green leafy vegetables, wild spinach or pumpkin. Black urban residents eat fruit and vegetables in small amounts, estimated at one small portion twice daily. A few studies in white and Indian urban residents have shown that fruit in all forms is eaten in small quantities, about two to three times weekly. Vegetables are also consumed in small amounts at two main meals and different types of cooking fat may be added during preparation.[40]

It is evident that there is a paucity of data on fruit and vegetable consumption in South Africa, especially on a national level. A substantial quantity of information was collected during the NFCS, providing scope for further analyses. Consequently, this study aimed to describe fruit and vegetable consumption in South African children and identify specific socio-economic factors impacting on this consumption, using data from the 1999 South African NFCS. Additionally, the procurement of fruit and vegetables, household income and nutritional status of the children were also investigated. Findings could provide health educators and policy-makers with documented scientific evidence for the development of policies and programs for promotion, education, advocacy and agricultural interventions, in terms of fruit and vegetable consumption.

On a global level, the WHO intends to promote an increase in fruit and vegetable consumption, through targeted campaigns and programmes so that adequate quantities of fruit and vegetables

become part of the daily diets in all countries.[55] Knowledge of the actual intake distribution is required for the strategies to be established and to assess what adjustments need to be made if recommendations are to be met. It is thus important to be able to measure intake for both quantitative recommendations and in order to monitor change.[8] When reviewing the literature, it is clear that compelling evidence exists to support the need for the development and implementation of effective programmes and policies that aim to increase the consumption of fruit and vegetables among children. The quantification of fruit and vegetable intake in South Africa is important for this worldwide drive to increase consumption and for the development of strategies to address inadequate consumption.

CHAPTER 2: METHODOLOGY

2.1 RESEARCH AIMS

2.1.1 Aim

The aim of this study was to estimate the fruit and vegetable consumption of a representative sample of children between the ages of 12 and 108 months (1 to 9 years) in South Africa using data from the 1999 South African National Food Consumption Survey (NFCS).

2.1.2 Specific objectives

Specific objectives were to:

- Determine fruit and vegetable consumption in children nationally, provincially and by age in terms of mean consumption per capita (grams per day)
- Determine the percentage of children who consume fruit and vegetables, nationally, provincially and by age
- Determine the daily frequency of consumption of fruit and vegetables, nationally, provincially and by age
- Relate the consumption, the percentage of children consuming, and the frequency of consumption of fruit and vegetables, to the anthropometric status of the children
- Relate consumption, the percentage of children consuming, and the frequency of consumption of fruit and vegetables, to indicators of socio-economic status, namely head of household, household income and education level of the mother
- Describe the procurement of fruit and vegetables, nationally and provincially

2.2 HYPOTHESES

- There is no association between the consumption of, the percentage of children consuming, and the frequency of consumption of fruit and vegetables, in South African children, aged 12 - 108 months and their anthropometric status.

- There is no association between the consumption of, the percentage of children consuming, and the frequency of consumption of fruit and vegetables, in South African children, aged 12 - 108 months, and head of household, household income and the education level of the mother.

2.3 STUDY DESIGN AND ETHICS

2.3.1 Study Design

The secondary analysis was designed as a cross-sectional analytical study, using a nationally representative sample, with provincial representation, of children aged 12 - 108 months in South Africa.

2.3.2 Ethical and Legal Aspects

A research protocol for this study was submitted to and approved (Project number: N06/03/048) by the Human Research Committee of the Faculty of Health Sciences, University of Stellenbosch, Tygerberg, South Africa. Written permission for use of the NFCS database was requested from and granted by the Directors of the NFCS.

2.3.3 Informed consent and patient confidentiality

In the NFCS, written consent was obtained from each participant's next of kin as appropriate prior to the commencement of the survey. This person was informed of the purpose of the study, the confidentiality of the collected data and the participant's right to refuse or terminate participation at any time during the interview.[34]

A waiver of informed consent was requested from and granted by the Human Research Committee of the Faculty of Health Sciences, University of Stellenbosch, under the following conditions:

- The information for the NFCS has been collected and will be analysed in such a way as to protect patient confidentiality. The NFCS database is configured using only study codes and identifying information linked to the study code is kept completely separately in a password protected database. Access to this information is restricted to the National Director of the NFCS only.
- The research will produce valuable information that may well benefit the community.

During the analyses for this study, confidentiality of information was observed at all times. The names of the subjects and mothers/caregivers were not revealed to the researchers at any time.

2.4 STUDY POPULATION AND SAMPLING

2.4.1 Study population

The study population consisted of children aged 12 - 108 months in South Africa. The children were selected from the database of the NFCS (n = 2894), conducted in 1999 and which, at the directive of

the national DOH, was over-sampled by 25% for children from low socio-economic areas. This was a nationally representative sample, with provincial representation, which was selected using the 1996 census data.[34]

2.4.2 Sampling

For the NFCS, the 1996 population census data were used as a sampling frame. This sampling frame was stratified into 156 enumerator areas (EAs), 82 of which were urban and 74 non-urban. The distribution of EAs within each province was established in proportion to the distribution of the national population, as well as the urban versus non-urban distribution in each province. On commercial farms only EAs with at least six suitable households were considered for inclusion and in formal and informal urban and tribal areas, only EAs with at least 16 suitable households were considered for inclusion. This was done for both practical and fiscal purposes. All other qualifying EAs for the survey were randomly selected. These areas consisted of all socio-economic groups found in all provinces of South Africa.[34, 56]

A suitable household was defined as a household with at least one child between the ages of 12 and 108 months living in the household. An adapted form of 'snowball sampling' was then used to set up a partial sampling frame. This entailed the random selection of a number of households in each EA in which it was asked whether there were other households in the area with children in the stipulated age range of the study. In due course, a list was drawn up of suitable households in the EA with children in the stipulated age range. The required number of households was then randomly selected from this list and a random starting point within each EA was selected. If there was more than one child that qualified in a household, a random number table was used to select one child in the household for inclusion in the survey sample.[34, 56]

2.4.3 Sample selection and weighting procedures

The proposed self-weighted minimum sample of 2200 children was created in accordance with the population size in the nine provinces, stratified for age, urban and rural habitation and provincial and national representation. It was required that there be a minimum of 50 observations per province and per urban/rural strata for the 24-H-RQ. The proposed minimum sample was therefore increased to 2440. This sample was then modified by means of 50% over-sampling. Over-sampling of 25% was implemented to make provision for children that would not be at home at the time of contact and the other 25% over-sampling was implemented to accommodate for children from low socio-economic areas, at the directive of the National DOH. The total number of children to be included in the survey was 3120. The response rate was 93%, which meant that a total sample of 2894 children were included.[34, 56]

It was therefore deemed necessary to adjust the sample to the original 2200. This was done by calculating weights based on these adjustments. The first step in adjusting the sample was to calculate the base weight, which is the component of the sample weight that accounts for the differential probabilities of selection. This is defined as the inverse of the inclusion probability of the individual in the sample. In this instance, the base weights included adjustments for a minimum stratum size of 50 subjects, the requirement that the stratum size had to be a multiple of 20, and over-sampling for high-risk areas.[56]

The following step in calculating the final weights involved post-stratification, in order to adjust the sample weights of the responding subjects so that the totals over various demographic categories matched known population totals. The post-stratification cells included age categories, and the known population totals were derived from the 1996 census figures. This adjustment provided for sampling frame inadequacies and non-responses. The final totals were then calculated separately for each age group, within each stratum (province, urban versus rural) and the final weighted sample comprised 2200 children.[56]

From the results, it was apparent that some under-representation was present in the original 7 - 8.9 year old age group. This was thought by the authors to most likely be due to some, or many, of these children being in school during the survey and it was not always possible to visit the schools and the households within the fixed time frame. With weighting, the sample size of this group increased. Furthermore, the over-sampled high-risk groups, which were found mainly in rural areas and farms, decreased. Despite these adjustments, the weighted and non-weighted findings were comparable in most categories, with 1% to 3% differences in 90% of categories. The results of this process, including the details of the weighted and non-weighted sample sizes, have been published elsewhere.[56]

2.5 NFCS METHODOLOGY

A comprehensive and detailed description of the methodology of the NFCS has been published elsewhere, thus only a brief explanation is provided. All questionnaires used in the NFCS to collect data, were designed, tested, validated specifically for the survey.[34]

2.5.1 Socio-economics

A socio-demographic questionnaire was developed and used to obtain information related to household food security and care of women and children. The socio-demographic questionnaire also provided information on factors relevant to the household in terms of the environment in which the child lived. Amongst others, questions were asked about the head of the household, the household income and the education level of the mother.[34]

2.5.2 Dietary intake

Two methods of individual dietary assessment were used in the NFCS to measure the dietary intake of children aged 12 - 108 months, namely a pre-coded 24-H-RQ and the quantitative food frequency questionnaire (QFFQ). The methods used for development, validation and reproducibility of the 24-H-RQ and QFFQ used in the NFCS have been published elsewhere.[34]

The 24-H-RQ was used by a trained interviewer to record the dietary intake of a child with the child's mother/caregiver. During this interview the respondent was requested to recall all the food and beverages consumed by the child over the previous 24 hours, starting with when the child woke up. The objective of this recall was to obtain information on the quantity and quality of the current diet eaten by children. The 24-H-RQ had categories specifically for the recording of fruit intake and vegetable intake.[34]

The QFFQ was administered by fieldworkers, who had been specifically trained for this purpose. The QFFQ provided information on the eating patterns and food consumption over the preceding six months for children older than 24 months and over the preceding 1 month for children between the ages of 12 and 23 months. Seasonality effects could therefore be examined. A food consumed less than once a month was marked as 'Seldom' and ignored for the analysis. The QFFQ had categories specifically for the recording of fruit consumption and vegetable consumption.[34]

To assist with accurate estimation of portion size in the NFCS, each fieldworker was supplied with a comprehensive kit containing food model aids and other dietary aids such as spoons and cups. The type of dietary aids included were selected based on foods commonly consumed by children in South Africa. The video used to train and standardize interviewers, contained a demonstration and clarification on the use of the dietary aids. The dietary assessment questionnaires included volumes and weight conversions of common household quantities of most of the food types. The portion usually eaten could be reported by the subject in household measures and then converted to volumes and weights by the fieldworker.[34]

The pre-coded 24-H-RQ contained an extensive list of fruit and vegetables, expressed as single foods and in the forms consumed most commonly in South Africa. The QFFQ used in the NFCS included 12 fruits and 16 vegetables expressed as single foods, which are commonly eaten by children in South Africa. The QFFQ used in the NFCS included various composite vegetable dishes commonly consumed by children in South Africa.[34]

2.5.3 Anthropometry

Weight, height, age and gender were determined as part of the methodology of the NFCS.[34] All anthropometric measurements were made in accordance with recommended techniques.[2] The data were compared with those of the National Center of Health Statistics (NCHS) of the USA using Epi Info version 6.02. Ages were re-calculated as “biologic" ages, i.e. dividing the year into 12 equal segments. For each child, a Z-score (i.e. the number of standard deviations (SDs) from the reference population median) was calculated for height-for-age (HAZ), weight-for-age (WAZ), and weight-for-height (WHZ).[34]

2.5.4 Food Procurement

At the population level, data were collected using a Food Procurement and Household Inventory Questionnaire (FPHIQ). The FPHIQ obtained data on, amongst other things, food procurement patterns, the source of foods, the food purchasing patterns and the frequency foods purchased.[34]

In the NFCS, food procurement was defined as the method of obtaining food used by the HH from all sources and included food grown, livestock reared, food donated and/or food purchased. The food procurement part of the FPHIQ, i.e. investigating where people get their food from, was administered in all the randomly selected households of all EAs.[34]

2.6 METHODS OF DATA PROCESSING AND STATISTICAL ANALYSIS

2.6.1 Definition of fruit and vegetables

When measuring fruit and vegetable consumption, the WHO proposes to include as vegetables the edible components of plants commonly seen as vegetables, foods used as vegetables such as fresh green pulses and sprouts, fresh sweet corn and botanical fruits used as vegetables (e.g. tomatoes, peppers, cucumbers, eggplants, and seaweed). Potatoes, cereals, tubers and dry pulses are therefore not classified as vegetables. Fruits should include all fruits that are fresh, canned, frozen and dried unless they are considered to be vegetables. This is regardless of the high energy content in, for example, avocados, olives and nuts. Only fruit juices that are 100% pure should be classified

as fruit.[8] The categorisation used by the South African Food Based Dietary Guidelines follows the above WHO guidelines, except that fruits with high energy contents are classified in the fats and oils group and are not regarded as fruit.[40] For the purposes of this study, the classification of fruit and vegetables followed that of the South African Food Based Dietary Guidelines. In the NFCS database, potatoes, sweet potatoes and mealies/sweet corn are included as vegetables and were therefore specifically excluded from the analysis for this study.

2.6.2 Use of data and approach to data processing

All children with a complete set of dietary data were included in the dietary analyses for this study. Similarly, all children with complete socio-demographic records were included and all children with complete anthropometric data were included. All the households with complete food procurement data were included in this secondary analysis. The adjusted sample size of 2200 subjects was used for all analyses. Data were analyzed with SAS 9.1 for Windows (SAS Institute, Cary, NC, USA). Dietary intake data collected using the 24-H-RQ were analyzed separately to dietary intake data collected by the QFFQ. The data were analyzed to determine the consumption of both fruit and vegetables as well as the consumption of only fruit and of only vegetables.

Mean intakes per capita were determined by adding all the individual intakes (in grams) obtained from each subject that ate fruit and vegetables, or fruit, or vegetables, by the dietary intake questionnaires (24-H-RQ and QFFQ). This total intake (in grams) was then divided by the total number of people who completed the dietary intake questionnaire (the n-value or total sample size). Mean intakes (in grams) were also determined for ‘eaters’, by adding all the individual intakes (in grams) obtained from each subject by the dietary intake questionnaires (24-H-RQ and QFFQ). This total intake (in grams) was then divided by the number of ‘eaters’ to determine the mean intakes (in grams) per ‘eaters’ of fruit and vegetables.

2.6.3 Methods of analysis of dietary data from 24-H-RQ

The dietary data on fruit and vegetable consumption provided by the pre-coded 24-H-RQ were analyzed and the MEANS Procedure, which is part of the SAS program, was used to determine the mean fruit and vegetable consumption per capita per day in grams and the mean percentage of children consuming fruit and vegetables. The percentage of children consuming fruit and vegetables will be referred to as ‘eaters’, for the purposes of this thesis. This analysis was done for the national sample (RSA), by province and by age group, namely 1 - 3 years, 4 - 6 years and 7 - 8.9 years. Confidence intervals (95%) and standard deviations (SD) were also generated using the MEANS Procedure. The chi-square test was used to test for differences in the percentages of children consuming fruit and vegetables in the various provinces. The Pairwise t-test was used to compare

the mean daily fruit intake per capita (in grams) with the mean daily vegetable intake per capita (in grams) in the national sample. The MEANS Procedure was also used to determine the three fruits and the three vegetables that were consumed in the largest quantities (mean grams per capita per day) by the children, at the time of the survey.

Limpopo, previously known as Northern Province, will be referred to as Limpopo in this analysis.

The same categorization of the children's anthropometric data, according to the calculated Z-scores for height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ), applied in the NFCS and described briefly above, was used in this study. The categorization is as follows:

- less than minus two standard deviations (< -2 SD)
- greater than or equal to minus two standard deviations, to less than or equal to plus two standard deviations (≥ -2 SD to ≤ +2 SD)
- greater than plus two standard deviations (> +2 SD).

The MEANS Procedure was then used to determine the mean fruit and vegetable consumption per capita per day in grams and the mean percentage of children consuming fruit and vegetables ('eaters'), in each of the above categories for HAZ, WAZ and WHZ and confidence intervals (95%) and standard deviations were generated.

A Z-score cut-off point of < -2 SD was used to classify low weight-for-age (underweight), low height-for-age (stunting) and low weight-for-height (wasting) and the cut-off point of > +2 SD classified high weight-for-height and weight-for-age, as overweight in children. This is in accordance with cut-offs used by the NFCS and the WHO Global Database on Child Growth and Malnutrition.[1, 34]

The Bonferroni (Dunn) t-test was used to show differences in mean fruit and vegetable intake by children and to show differences in the mean percentages of children eating fruit and vegetables, in the various anthropometric categories (< -2 SD; ≥ -2 SD to ≤ +2 SD; > +2 SD) for HAZ, WAZ and WHZ.

The MEANS Procedure was used to determine the mean daily energy intake per capita of children in the anthropometric categories < -2 SD and ≥ -2 SD for HAZ, WAZ and WHZ and confidence intervals (95%) and standard deviations (SD) were generated. The Wilcoxon two-sample test was used to compare these mean daily energy intakes in stunted children (HAZ < -2 SD) and non-stunted children (HAZ ≥ -2 SD), in underweight (WAZ < -2 SD) and non-underweight (WAZ ≥ -2 SD), children and in wasted (WHZ < -2 SD) and non-wasted children (WHZ ≥ -2 SD).

The MEANS Procedure was again used in the analysis of the 24-H-RQ data, to determine the mean fruit and vegetable consumption per capita per day in grams and the mean percentage of children consuming fruit and vegetables ('eaters'), by head of household, by household income and by education level of the mother. Household headship categories used for the analysis were father-headed households, mother-headed households, grandfather-headed households, grandmother-headed households and other-headed households. Household income categories used for the analysis were no income (none), R100 to R500, R500 to R1000 and greater than R1000 per month. Categories used for education level of the mother were no formal education, primary school education, high school education and tertiary education.

The Bonferroni (Dunn) t-test was used to show differences in mean fruit and vegetable intake by children, and to show differences in the mean percentages of children eating fruit and vegetables, in the various head of household, household income and education level of the mother categories.

The dietary intake data from the 24-H-RQ were analyzed using the FREQ Procedure, which is part of the SAS program, to establish the percentage of children consuming less than the WHO recommendations (theoretical-minimum-risk distribution[33]) for fruit and vegetable intake for children aged 0 - 4 years (estimated at 330 grams per day) and 5 to 8 years (estimated at 480 grams per day), in the different anthropometric categories (< -2 SD; ≥ -2 SD to ≤ +2 SD; > +2 SD) for HAZ, WAZ and WHZ. The chi-square test was used to test for differences in these percentages of children in the different anthropometric categories for HAZ, WAZ and WHZ.

The 24-H-RQ data were analyzed using the FREQ Procedure, to establish the percentage of children consuming less than the WHO recommendations (theoretical-minimum-risk distribution[33]) for fruit and vegetable intake for children aged 1 to 4 years (estimated at 330 grams per day) and 5 to 8 years (estimated at 480 grams per day), in the different head of household categories. The chi-square test was used to test for differences in these percentages of children in the father-headed households, mother-headed households, grandfather-headed households, grandmother-headed households and other-headed households.

The 24-H-RQ data were analyzed using the FREQ Procedure, to establish the percentage of children consuming less than the WHO recommendations (theoretical-minimum-risk distribution[33]) for fruit and vegetable intake for children, as above, in the various household income categories. The chi-square test was used to test for differences in these percentages of children in the households with no income, with a monthly income of R100 to R500, R500 to R1000 and greater than R1000.

The 24-H-RQ data were analyzed using the FREQ Procedure, to establish the percentage of children consuming less than the WHO recommendations (theoretical-minimum-risk distribution[33]) for fruit and vegetable intake for children, as above, in the various education level of mother categories. The chi-square test was used to test for differences in these percentages of children whose mothers had no formal education, had a primary education, had a secondary education or had a tertiary education.

2.6.4 Methods of analysis of dietary data from QFFQ

The dietary data provided by the QFFQ, was analysed and the MEANS Procedure, which is part of the SAS program, was used to determine the mean fruit and vegetable consumption per capita per day in grams, the mean percentage of children consuming fruit and vegetables ('eaters') and the mean frequency of intake of fruit and vegetables in terms of number of times per day. This analysis was done for the national sample (RSA), by province and by age group, namely 1 - 3 years, 4 - 6 years and 7 - 8.9 years, and confidence intervals (95%) and standard deviations (SD) were also generated using the MEANS Procedure. Fruit and vegetable intake was obtained from the QFFQ by summing the reported frequency multiplied by the amount consumed and expressed in grams consumed per day. The chi-square test was used to test for differences in the percentages of children consuming fruit and vegetables in the various provinces. The Pairwise t-test was used to compare the mean daily fruit intake per capita (in grams) with the mean daily vegetable intake per capita (in grams) in the national sample. The MEANS Procedure was also used to determine the three fruits and the three vegetables that were consumed in the largest quantities (mean grams per capita per day) by the children, at the time of the survey.

As in the NFCS, the anthropometric data were categorized according to the calculated Z-scores for height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ), as follows:

- less than minus two standard deviations (< -2 SD)
- greater than or equal to minus two standard deviations, to less than or equal to plus two standard deviations ($\geq$ -2 SD to $\leq$ +2 SD)
- greater than plus two standard deviations (> +2 SD).

The MEANS Procedure was then used to determine the mean fruit and vegetable consumption per capita per day in grams, the mean percentage of children consuming fruit and vegetables ('eaters') and the mean frequency of intake of fruit and vegetables in terms of number of times per day. This was done for children in each of the above categories for HAZ, WAZ and WHZ and confidence intervals (95%) and standard deviations (SD) were generated.

A Z-score cut-off point of < -2 SD was used to classify low weight-for-age (underweight), low height-for-age (stunting) and low weight-for-height (wasting) and the cut-off point of > +2 SD classified high weight-for-height and weight-for-age as overweight in children. This is in accordance with cut-offs used by the NFCS and by the WHO Global Database on Child Growth and Malnutrition.[1, 34]

The Bonferroni (Dunn) t-test was used to show differences in mean fruit and vegetable intake in children, in the different anthropometric categories (< -2 SD; ≥ -2 SD to ≤ +2 SD; > +2 SD) for HAZ, WAZ and WHZ. The Bonferroni (Dunn) t-test was also used to show differences in the mean percentages of children eating fruit and vegetables and to show differences in the mean frequency of intake of fruit and vegetables by children in terms of number of times per day, in the different anthropometric categories for HAZ, WAZ and WHZ.

The MEANS Procedure was used to determine the mean daily energy intake per capita of children in the anthropometric categories < -2 SD and ≥ -2 SD for HAZ, WAZ and WHZ and confidence intervals (95%) and standard deviations (SD) were generated. The Wilcoxon two-sample test was used to compare these mean daily energy intakes in stunted children (HAZ < -2 SD) and non-stunted children (HAZ ≥ -2 SD), in underweight (WAZ < -2 SD) and non-underweight (WAZ ≥ -2 SD), children and in wasted (WHZ < -2 SD) and non-wasted children (WHZ ≥ -2 SD).

The QFFQ was analyzed and the MEANS Procedure was again used to determine the mean fruit and vegetable consumption per capita per day in grams, the mean percentage of children consuming fruit and vegetables (‘eaters’) and the mean frequency of intake of fruit and vegetables in terms of number of times per day, by head of household, by household income and by education level of the mother. Household headship categories used for the analysis were father-headed households, mother-headed households, grandfather-headed households, grandmother-headed households and other-headed households. Household income categories used for the analysis were no income (none), R100 to R500, R500 to R1000 and greater than R1000 per month. Categories used for education level of the mother were no formal education, primary school education, high school education and tertiary education.

The Bonferroni (Dunn) t-test was used to show differences in mean fruit and vegetable intake by children, and to show differences in the mean percentages of children eating fruit and vegetables, in the various head of household, household income and education level of the mother categories.

2.6.5 Methods of analysis of food procurement data

The FPHIQ data were analyzed using the FREQ Procedure, to establish the source of procurement of fruit and vegetables, expressed as a percentage of households procuring fruit and vegetables from one of the following sources: purchased, grown and other (included reared, grown and milled, picked – wild, hunted / fished, part of payment, barter, homemade, clinic / NGO / Institution, donations / gifts, other). This was done nationally, provincially, by head of household, by monthly household income and by education level of the mother. The analyses were done for fruit and/or vegetables, for fruit alone and for vegetables alone.

The FPHIQ data were then analyzed using the FREQ Procedure, to establish the frequency of purchase of fruit and vegetables, expressed as a percentage of households, purchasing fruit and vegetables at one of the following frequencies: daily/2 x week, weekly, fortnightly, monthly and on special occasions. This was done nationally, provincially, by head of household, by monthly household income and by education level of the mother. The analyses were done for fruit and/or vegetables, for fruit alone and for vegetables alone.

CHAPTER 3: RESULTS

3.1 SAMPLE CHARACTERISTICS AND RELEVANT RESULTS FROM THE NFCS

For the NFCS, the survey population consisted of children aged 12 - 108 months in South Africa. The data collection period was between February and July 1999. There was a response rate of 93% and of the 3120 subjects in the originally designed inclusion strategy and data were obtained for 2894 children.[34]

A reasonably even distribution by gender was achieved in the survey sample, both at the national and provincial level. As a result of the sampling strategy employed, the number of children studied varied among provinces, as expected. Children of all the age groups selected were well represented in the study sample with the exception of the 7 – 8.9 year old children, which was a smaller group. The highest number of children was in the 1 - 3 years age group (n = 1320), with 1090 children in the 4 - 6 years age group and 484 children in the 7 – 8.9 years group. The smaller number in the 7 – 8.9 years group was thought to be due either to a consistent sampling error or alternatively to children in this age group having been replaced as they were more likely to have been at school at the time of the interview. The total number of children in the defined age groups of the survey did not vary significantly according to the data of the 1996 Census.[34]

In reporting the findings of this secondary analysis study, it would be pertinent to consider briefly the relevant socio-economics findings of the NFCS. This is necessary in order to report the associations between fruit and vegetable intake and the selected socio-economic indicators, within the context of the socio-demographic picture, painted by the original survey.

The NFCS found that nationally, the father was the head of the household in 42% of the households. In only 11% of the households the mother was the head and this tended to be more often the case in households in formal and informal urban areas. In the remainder of the households, grandparents, more commonly the grandmother headed the household.[34]

One out of ten mothers of children of all age groups had no formal education, according to the NFCS. Three out of four mothers had attained a certain level of education, with 25% of mothers having had primary school, 27% high school and 8% tertiary level education. The provinces with the highest percentage of mothers who had no formal education included the Northern Cape (23%), Mpumalanga (16%), Limpopo (13%), whereas the Western Cape had the lowest percentage of formally uneducated mothers (3%). A similar picture emerged for the education level of the caregivers of the children, except that overall they achieved a lower education status and a higher

percentage of them were not formally educated. However, the attained level of education was unknown in approximately one third of the caregivers.[34]

The NFCS found that nationally, one third of the households in the NFCS had a monthly income of between R 100 and R 500. This income range was characteristic of households in rural, tribal and informal urban areas as well as of households on commercial farms. Only 4% of the households reported a monthly income range respectively of R 3000 to R 5000 or greater than R 5000, with approximately one out of two households having an income range of between R500 to R 3000. This pattern of income range was the same for households with children of all the age groups in the NFCS. The provinces with greater than 30% of households that reported an income in the lowest range included the Eastern Cape, Free State, KwaZulu/Natal, Northern Cape and the North West.[34]

In reporting the findings of this secondary analysis study, it would also be pertinent to briefly consider the key dietary findings of the NFCS. This is necessary in order to report the fruit and vegetable consumption within the context of the total diet being eaten by the children, as determined by the original survey.

On the basis of the 24-H-RQ, the NFCS found that, on a national basis and in general, one out of two children aged 1 – 8.9 years had an intake of approximately less than half of the recommended level for energy and a number of key micronutrients. The latter included vitamin A, vitamin C, riboflavin, niacin, vitamin B6, folate, calcium, iron and zinc. This was found despite the documented and expected increase in mean intake of each nutrient with age. Almost 96% of the children were reported to follow their usual eating pattern on the day of the administration of the 24-H-RQ questionnaire. On the basis of the QFFQ, at least one out of three children had an intake of approximately less than half of the recommended level for a number of important nutrients. A significant majority of children consumed a diet deficient in energy and a number of micronutrients, including calcium, iron, zinc, selenium, vitamin A, vitamin D, vitamin C, vitamin E, riboflavin, niacin and vitamin B6.[34]

The findings from the QFFQ are largely very supportive of those obtained by the 24-H-RQ, although, as expected, nutrient intake, in absolute values, were higher when obtained by the QFFQ as compared with the 24-H-RQ.[34]

The information for the completion of the questionnaires was mostly provided by the mother (63%) or a grandparent (21%) of the child and this was the case for children of all age groups and in all provinces.[34]

In reporting the findings of this secondary analysis study, it would be equally pertinent to consider briefly the main anthropometric findings of the NFCS. This is necessary in order to report the associations between fruit and vegetable intake and anthropometric status, within the context of the NFCS anthropometric results.

The findings of the NFCS indicated that one in ten of all children aged 1 – 8.9 years was underweight and just more than one in five was stunted. Anthropometrically, a low (<5%) prevalence of wasting, a low (<10%) prevalence of being underweight and a medium (20 – 29.9%) prevalence of stunting was documented at the national level. Those that lived in the rural areas and on commercial farms were more severely affected. The level of maternal education was found to be an important determinant for these nutritional disorders. The findings clearly indicated that the 1 - 3 year old age group was the most severely affected, having approximately a two-fold higher prevalence of stunting and of being underweight. At the national level, the prevalence of being overweight was at 6%, but a two-fold higher prevalence (12%) was seen in children of well-educated mothers living in urban areas as compared with the national average.[34]

Nutritional status varied considerably between urban and rural populations and among provinces. The prevalence of wasting, although low (<5%), varied from 0.9 % in the Western Cape, to 5.7% in the North West, to 7.5 % in Limpopo and to 9.6 % in the Northern Cape. The prevalence of being underweight varied from a low (<10%) of 4.2 % in Mpumalanga to a medium (10 - 19.9) of 15 % in Limpopo and 15.3 % in the North West and to a high (20 - 29.9) 23.7% in the Northern Cape, almost a six-fold difference. Similarly, there was almost a two-fold difference in the prevalence of stunting between the Western Cape (15%) and the Free State (30%), the latter being a high (30 - 39.9 %) prevalence.[34]

A secondary anthropometric data analysis of the NFCS in South Africa revealed a national prevalence of stunting at 19.3 %. When looking at weight-for-height, 3.3% of children in South Africa were wasted and the overall prevalence of overweight and obesity (body mass index $\geq$ 1 SD WHZ) was 19%.[56]

The results for this secondary analysis study will be reported for the consumption of both fruit and vegetables, as well as for the consumption of only fruit and of only vegetables. The consumption as determined by the 24-H-RQ and the QFFQ will be reported.

3.2 NATIONAL AND PROVINCIAL FRUIT AND VEGETABLE CONSUMPTION

For the purposes of this thesis, only the mean consumption of fruit and vegetables per capita will be reported, for comparisons with international research.

3.2.1 Daily fruit and vegetable consumption (in grams) per capita in South Africa and per province

The mean daily consumption per capita of fruit and vegetables in children aged 12 - 108 months in South Africa, amounted to 110.1 grams [Standard Deviation (SD) 150] (n = 2200) on the basis of the 24-H-RQ and 204.9 grams [SD 188.2] (n = 2133) on the basis of the QFFQ (Table 3.1; Figure 3.1). Analyzed by province the 24-H-RQ found the mean daily intake per capita of fruit and vegetables to be highest in the Western Cape at 183.7 grams [SD 167.8] (n = 239) and lowest in the Eastern Cape at 62.5 grams [SD 105 grams] (n = 341) (Table 3.1; Figure 3.1). The mean intake of fruit and vegetables measured by the 24-H-RQ in the other provinces, ranged from 80.3 grams [SD 98.5] (n = 177) in the North West to 135.2 grams [SD 124.5] (n = 239) in Limpopo (Table 3.1; Figure 3.1). The QFFQ also found the greatest consumption of fruit and vegetables in the Western Cape at 341.9 grams [SD 230.6] (n = 225), but the lowest intake was measured in the Northern Cape at 114.9 grams [SD 60.1] (n = 45) (Table 3.1; Figure 3.1). Other provinces had mean fruit and vegetable intakes between 133.1 grams [SD 84.2] (n = 176) in the North West and 247.2 grams [SD 192.7] (n = 405) in Gauteng, according to the QFFQ (Table 3.1; Figure 3.1).

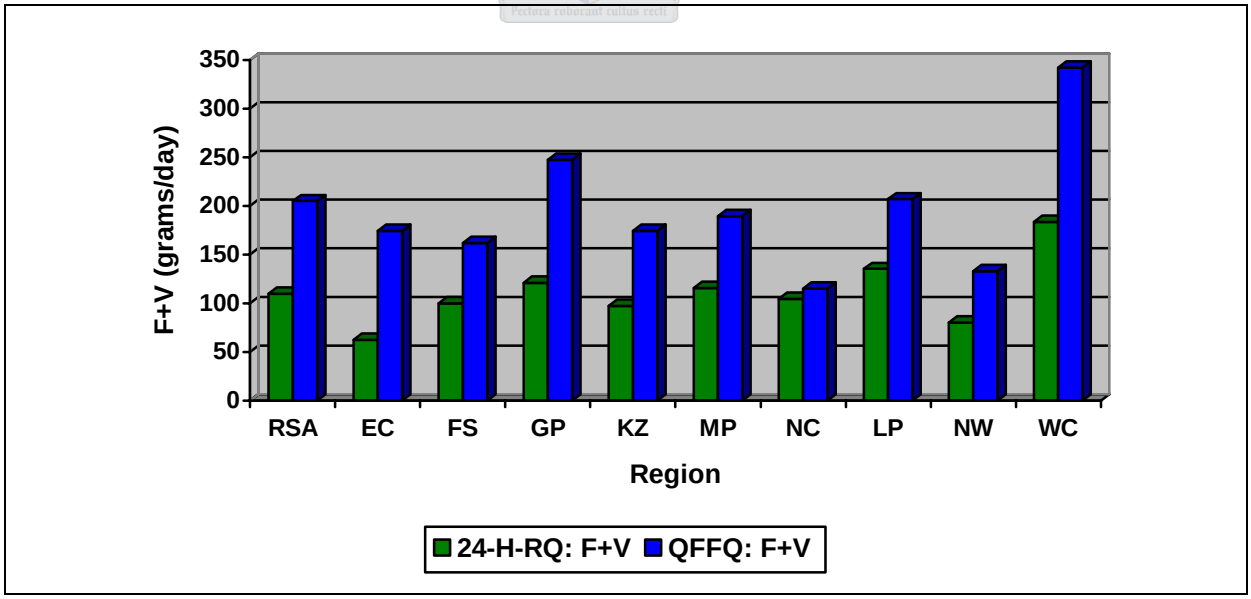

Figure 3.1: Mean daily intake (in grams) per capita of fruit and vegetables (F+V) in children in RSA and per province, as determined by the 24-H-RQ and QFFQ

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape

3.2.2 Daily fruit consumption (in grams) per capita in South Africa and per province

On the basis of the 24-H-RQ and QFFQ, the mean daily intake of fruit per capita in children aged 12 - 108 months in South Africa was 54.4 grams [SD 122.9] (n = 2200) and 115.2 grams [SD 159.1] (n = 2133), respectively (Table 3.1; Figure 3.2). Children in the Western Cape had the largest mean fruit consumption per capita per day according to both the 24-H-RQ (133.9 grams [SD152.1]) (n = 239) and QFFQ (249.3 grams [SD 208.3]) (n = 225) and these quantities were considerably higher than in the other provinces (Table 3.1; Figure 3.2). The 24-H-RQ found the smallest mean daily intake of fruit per capita at only 20 grams [SD 72.9] (n = 341) in the Eastern Cape, whilst this was found by the QFFQ to be the case in the Northern Cape (67.3 grams [SD 46.7]) (n = 45) and the North West (70.4 grams [SD 71.7]) (n = 176) (Table 3.1; Figure 3.2). Mean fruit intake measured by the 24-H-RQ in the other provinces, ranged from 38.5 grams [SD 84.9] (n = 239) in Limpopo to 65.3 grams [SD 137.8] (n = 417) in Gauteng (Table 3.1; Figure 3.2). This range for the QFFQ was 70.4 grams [SD 71.7] (n = 176) of fruit daily in the North West to 152.6 grams [SD 165.9] (n = 405) in Gauteng (Table 3.1; Figure 3.2).

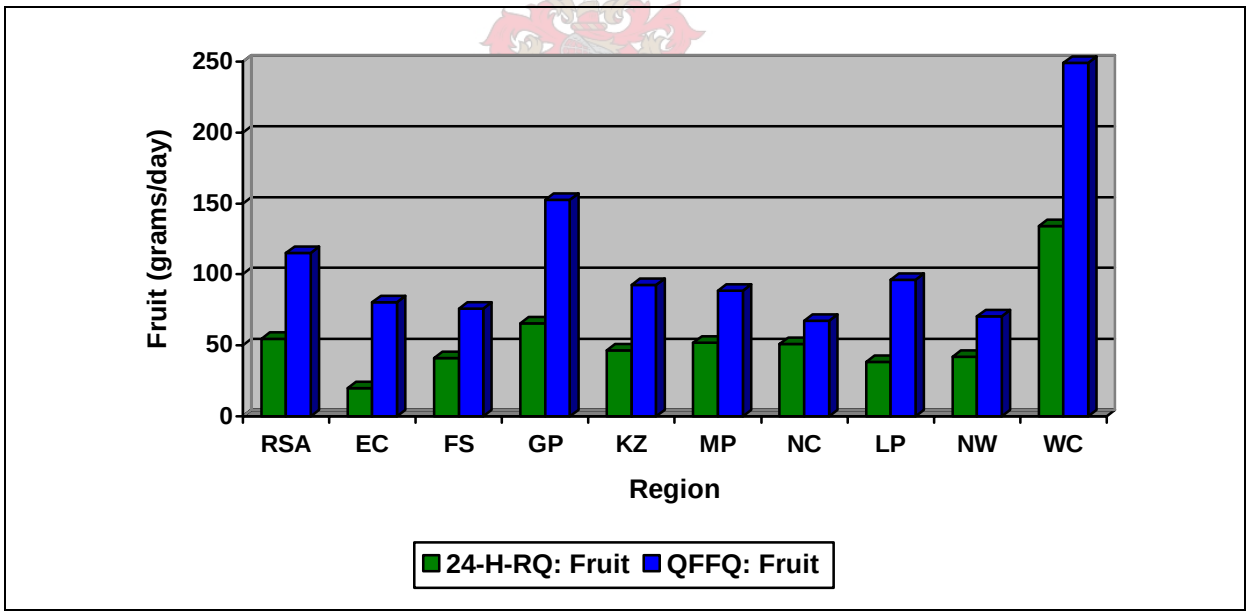

Figure 3.2: Mean daily intake (in grams) per capita of fruit in children in RSA and per province, as determined by the 24-H-RQ and QFFQ

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape

3.2.3 Daily vegetable consumption (in grams) per capita in South Africa and per province

Daily average vegetable consumption per capita in 12 - 108 month old children in South Africa was 55.7 grams [SD 79.6] (n = 2200) based on the 24-H-RQ and 89.7 grams [SD 77.3] (n = 2133) based on the QFFQ (Table 3.1; Figure 3.3). Analyses of vegetable consumption per province by the 24-H-RQ and QFFQ, established that children in Limpopo had the highest daily mean intake per capita at 96.7 grams [SD 97.6] (n = 239) and 110.7 grams [SD 103.8] (n = 226), respectively (Table 3.1; Figure 3.3). On the basis of the 24-H-RQ children in the North West had the lowest mean vegetable intake at 38.3 grams [SD 46.8] (n = 177) per day (Table 3.1; Figure 3.3). The mean daily intake per capita of vegetables in the other provinces ranged from 42.5 grams [SD 74.7] (n = 341) in the Eastern Cape to 64.1 grams [SD 85.2] (n = 154) in Mpumalanga (Table 3.1; Figure 3.3). The lowest mean daily vegetable intake measured by the QFFQ was in the Northern Cape at 47.5 grams [SD 25.8] (n = 45) (Table 3.1; Figure 3.3). The average daily consumption of vegetables in the other provinces ranged of 62.7 grams [SD 43.4] (n = 176) in the North West to 101.1 grams [SD 104.2] (n = 150) in Mpumalanga (Table 3.1; Figure 3.3).

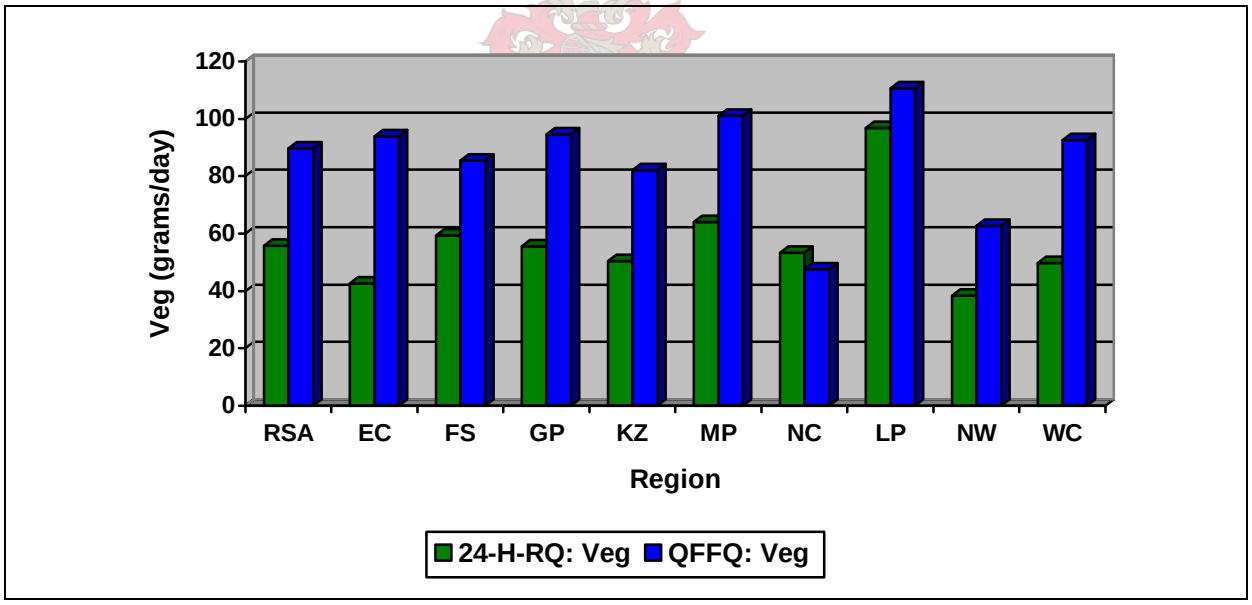

Figure 3.3: Mean daily intake (in grams) per capita of vegetables (Veg) in children in RSA and per province, as determined by the 24-H-RQ and QFFQ

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape

3.24 Comparison of fruit consumption and vegetable consumption in South Africa

On analysis of the 24-H-RQ data, the quantity of vegetables consumed (55.7 grams [SD 79.6]) (n = 2200) by the children was not significantly greater (Pairwise t-test p=0.6523) than the quantity of fruit consumed (54.4 grams [SD 122.9]) (n = 2200) (Table 3.1). When comparing the values obtained using the QFFQ, a significantly greater (Pairwise t-test p<0.0001) amount of fruit (115.2 grams [SD 159.1]) (n = 2133) was eaten than vegetables (89.7 grams [SD 77.3]) (n = 2133), at the national level (Table 3.1).

According to the 24-H-RQ, the three fruits that were consumed in the largest quantities by the children were apples (11.6 grams per capita per day), followed by orange juice (11.6 grams per capita per day) and bananas (6.7 grams per capita per day). The three most abundantly consumed vegetables were green leaves (marog, amaranth, beetroot, pumpkin) (14.5 grams per capita per day), cabbage (12.4 grams per capita per day) and pumpkin/butternut/hubbard squash (6.8 grams per capita per day). As per the QFFQ data, the three fruits that were eaten in the largest quantities were apples (28.9 grams per capita per day), bananas (17.2 grams per capita per day) and orange juice (14.5 grams per capita per day). The vegetables consumed in the largest quantities by the children were cabbage (19.2 grams per capita per day), pumpkin/butternut/hubbard squash (13.8 grams per capita per day) and spinach (11.4 grams per capita per day).

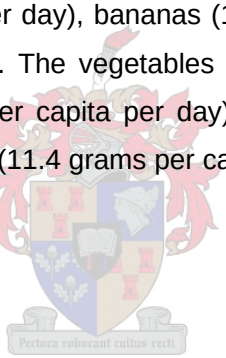

Table 3.1: Mean daily intake per capita (in grams) of fruit and vegetables in children in RSA and per province, as determined by the 24-H-RQ and QFFQ

Region			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (g) 95% CI SD		Mean (g) 95% CI SD		Mean (g) 95% CI SD	
	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
RSA	2200	2133	110.1 103.8 - 116.4 150	204.9 196.9 - 212.9 188.2	54.4 49.2 - 59.5 122.9	115.2 108.5 - 122 159.1	55.7 52.4 - 59.1 79.6	89.7 86.4 - 92.4 77.3
EC	341	333	62.5 51.4 - 73.7 105	174.3 158.5 - 190.1 146.8	20 12.3 - 27.8 72.9	80.5 68 - 92.9 115.8	42.5 34.6 - 50.5 74.7	93.9 85.5 - 102.3 78
FS	144	136	100.2 77.5 - 123.1 138.8	161.6 137.7 - 185.7 141.1	41 25.4 - 56.6 94.9	76 58.2 - 93.9 105.6	59.3 45.1 - 73.5 86.4	85.5 72.8 - 98.2 75
GP	417	405	120.8 104.6 - 136.9 167.7	247.2 228.3 - 266 192.7	65.3 52 - 78.5 137.8	152.6 136.4 - 168.8 165.9	55.5 46.5 - 64.5 93.1	94.5 86.7 - 102.3 79.5
KZ	446	438	97.2 81.1 - 113.3 173	174.4 155.6 - 193.1 199.4	46.7 33.1 - 60.4 147	92.3 75.9 - 108.6 173.9	50.5 43.4 - 57.6 76.4	82.1 75.3 - 88.9 72.5
MP	154	150	115.7 86 - 145.5 187	189.5 152.3 - 226.8 230.9	51.7 26.4 - 76.9 158.6	88.4 61.1 - 115.8 169.5	64.1 50.5 - 77.6 85.2	101.1 84.3 - 117.9 104.2
NC	43	45	104.5 72.9 - 136.2 105	114.9 97.1 - 132.6 60.1	51.2 30.5 - 71.9 68.6	67.3 53.5 - 81.1 46.7	53.3 36.1 - 70.5 57.1	47.5 39.9 - 55.2 25.8
LP	239	226	135.2 119.4 - 151 124.5	206.9 180.7 - 233.1 200.1	38.5 27.7 - 49.3 84.9	96.2 75.5 - 116.9 158	96.7 84.2 - 109.1 97.6	110.7 97.1 - 124.3 103.8
NW	177	176	80.3 65.7 - 94.9 98.5	133.1 120.6 - 145.6 84.2	42 29.5 - 54.5 84.4	70.4 59.8 - 81 71.7	38.3 31.4 - 45.2 46.8	62.7 57.6 - 67.8 34.4
WC	239	225	183.7 162.3 - 205 167.9	341.9 311.6 - 372.2 230.6	133.9 114.6 - 153.3 152.1	249.3 222 - 276.7 208.3	49.7 42 - 57.5 60.6	92.6 83.6 - 101.5 68.3

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape

3.2.5 Fruit and vegetable consumption and the WHO recommendations

In the 2004 WHO Comparative Quantification of Health Risks, the theoretical-minimum-risk distribution (WHO recommendations) for fruit and vegetable intake (excluding potatoes) was estimated to be 330 grams per day in children aged 0 - 4 years and 480 grams in children aged 5 - 14 years.[33] It is evident that nationally the mean fruit and vegetable consumption expressed either per capita or per 'eaters' (data not shown), did not meet even the lowest recommendation of 330 grams per day. At the provincial level, all provinces also fell short of this recommendation except for the Western Cape, where the QFFQ measured the mean daily intake of fruit and vegetables at 341.9 grams [SD 230.6] (n = 225) (Table 3.1).

3.2.6 Percentage of children consuming fruit and vegetables in South Africa and per province

On the basis of the 24-H-RQ, 56.6 percent (%) [SD 43.8] (n = 2200) of the children in South Africa aged between 12 and 108 months, consumed fruit and vegetables on the day prior to the interview (Table 3.2; Figure 3.4). On the basis of the QFFQ, 97.1 % [SD 14.8] (n = 2133) of children aged 12 - 108 months consumed fruit and vegetables over the defined time periods preceding the interview (Table 3.2; Figure 3.4). This period covered the preceding 6 months for children older than 2 years of age, and one month for children between 1 and 2 years of age. For the purposes of this thesis, subjects who consumed fruit and vegetables will be referred to as 'eaters'.

The 24-H-RQ found the highest percentage of fruit and vegetable 'eaters' in the Western Cape at 74.6 % [SD 35.7] (n = 239) and the lowest percentage in the Northern Cape at 39.8 % [SD 26.1] (n = 43) and the Eastern Cape at 40.4 % [SD 44.2] (n = 341) (Table 3.2; Figure 3.4). There was a significant (Chi-square $p<0.0001$) difference in the percentages of 'eaters' of fruit and vegetables in all the provinces, on analysis of the 24-H-RQ data. Gauteng (99.7 % [SD 5.4]) (n = 405) and the Western Cape (99.6 % [SD 5]) (n = 225) had the highest percentage of children consuming fruit and the Northern Cape the lowest at 90.4 % [SD 15.9] (n = 45), according to the QFFQ (Table 3.2; Figure 3.4). The Chi-square test found a significant (Chi-square $p<0.0001$) difference in the percentages of fruit and vegetable 'eaters', measured by the QFFQ, in the various provinces.

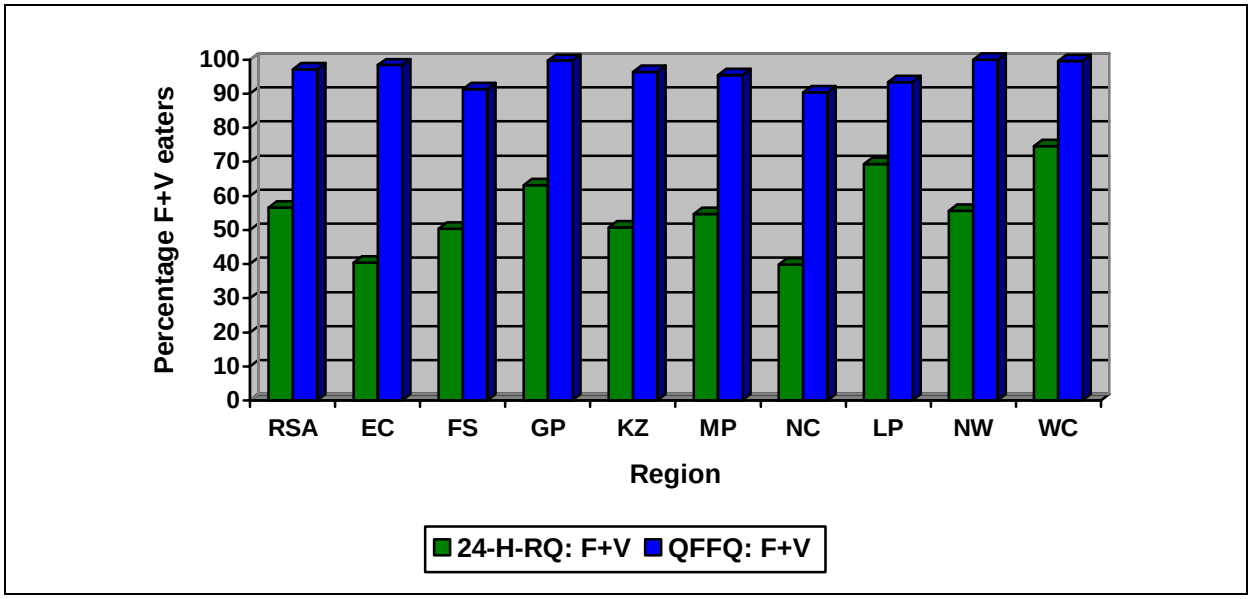

Figure 3.4: Mean percentages of children consuming fruit and vegetables (F+V eaters) in RSA and per province, as determined by the 24-H-RQ and QFFQ

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape

3.2.7 Percentage of children consuming fruit in South Africa and per province

Fruit was consumed by 22.1 % [SD 36.7] (n = 2200) of the children in South Africa on the day preceding the administration of the 24-H-RQ and on the basis of the QFFQ, 81.9 % [SD 34.1] (n = 2133) of children ate fruit in the preceding 6 months (children > 2 years) and 1 month (children 1 to 2 years) (Table 3.2; Figure 3.5). The greatest percentage of fruit 'eaters' on the day preceding the 24-H-RQ interview, was in the Western Cape at 52.2 % [SD 40.9] (n = 239) and the lowest in the Eastern Cape at 10.3 % [SD 27.3] (n = 341) (Table 3.2; Figure 3.5) and the percentages of fruit 'eaters in the various provinces were significantly different (Chi-square $p<0.0001$). The Western Cape had the highest percentage of children consuming fruit (99.2 % [SD 7.2]) (n = 225) in the time periods defined by the QFFQ, with the lowest percentage being in Mpumalanga (59.1 [SD 49.3]) (n = 150) (Table 3.2; Figure 3.5) and the percentage of 'eaters' of fruit differed significantly (Chi-square $p<0.0001$) in the different provinces.

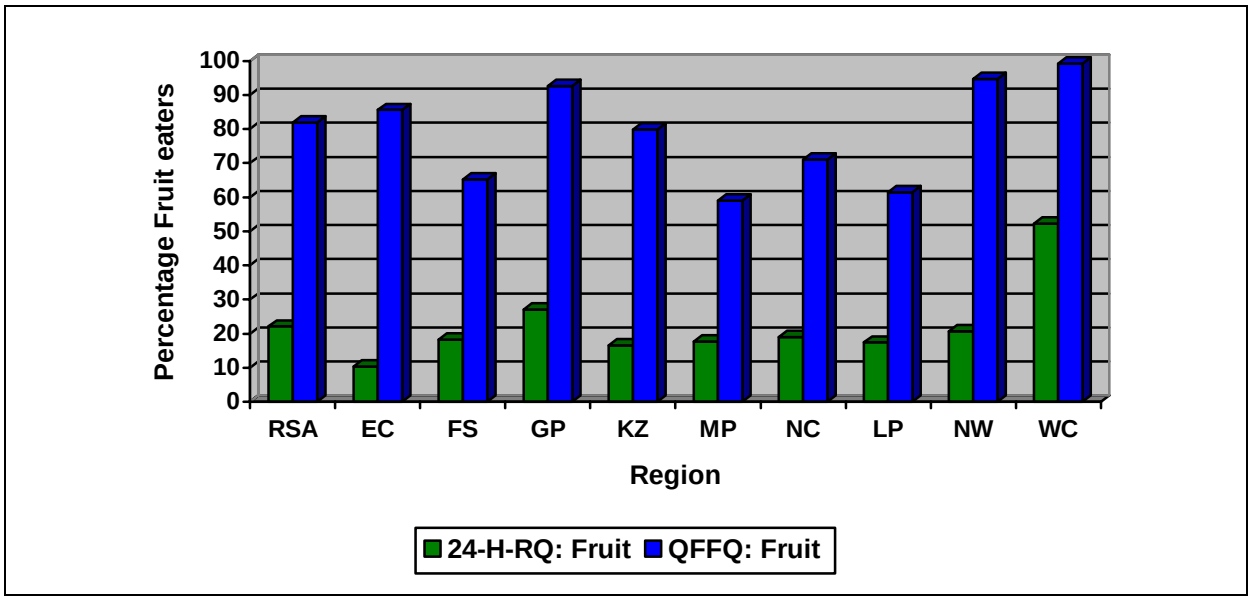

Figure 3.5: Mean percentages of children consuming fruit (Fruit eaters) in RSA and per province, as determined by the 24-H-RQ and QFFQ

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape

3.2.8 Percentage of children consuming vegetables in South Africa and per province

On the day prior the 24-H-RQ administration, 45.5 % [SD 44.0] (n = 2200) of the children in South Africa aged between 12 and 108 months, consumed vegetables (Table 3.2; Figure 3.6). On the basis of the QFFQ, 95.7 % [SD 18.1] (n = 2133) of 12 - 108 month old children in South Africa ate vegetables in the time periods defined by the QFFQ (Table 3.2; Figure 3.6). The greatest percentage of vegetable 'eaters' was found in Limpopo (61.2 % [SD 40.5]) (n = 239) with the Northern Cape having the smallest percentage of 'eaters' of vegetables (31.3 % [SD 24.8]) (n = 43), according to the 24-H-RQ (Table 3.2; Figure 3.6) and there was a significant (Chi-square $p<0.0001$) difference in the percentages of 'eaters' of vegetables in all the provinces. The highest percentage of children consuming vegetables in the time periods defined by the QFFQ, was found in the Western Cape (99.2 % [SD 7.2]) (n = 225), with the lowest percentage being in the Free State (88.1 % [SD 27.3]) (n = 136) (Table 3.2; Figure 3.6). There was a significant (Chi-square $p<0.0001$) difference in the percentages of vegetable 'eaters' in all the provinces, on analysis of the QFFQ data.

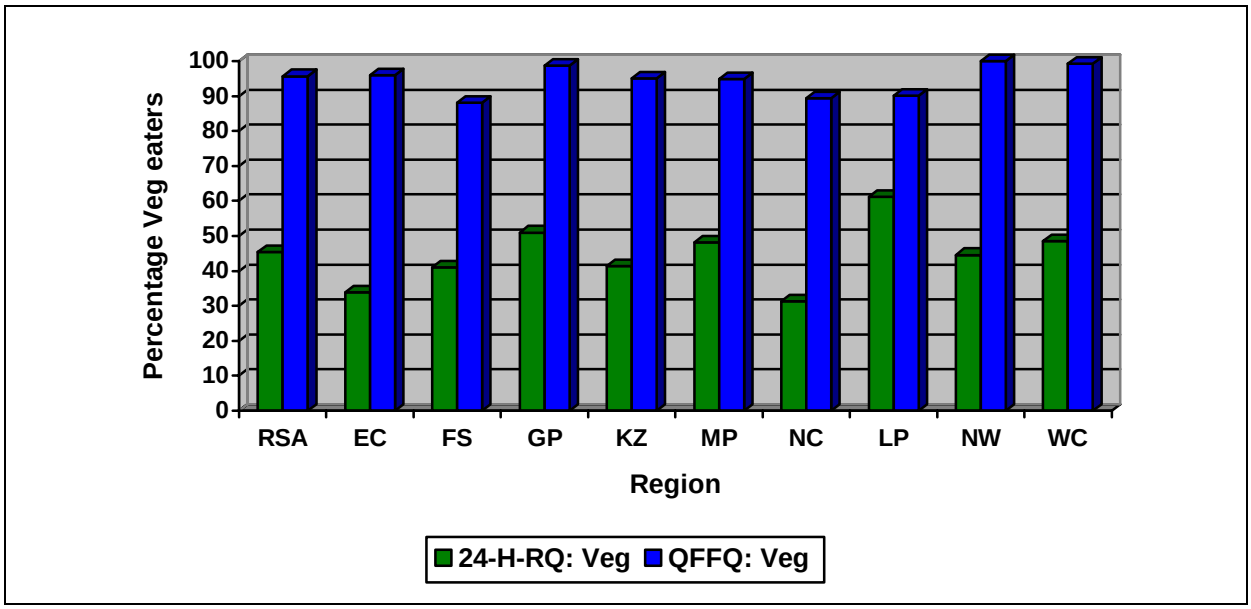

Figure 3.6: Mean percentages of children consuming vegetables (Veg eaters) in RSA and per province, as determined by the 24-H-RQ and QFFQ

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape

Table 3.2: Mean percentages (%) of children consuming fruit and vegetables in RSA and per province, as determined by the 24-H-RQ and QFFQ

Region			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (%) 95% CI SD		Mean (%) 95% CI SD		Mean (%) 95% CI SD	
	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
RSA	2200	2133	56.6 54.7 - 58.4 43.8	97.1 96.5 - 97.8 14.8	22.1 20.6 - 23.6 36.7	81.9 80.5 - 83.4 34.1	45.5 43.7 - 47.3 44	95.7 94.9 - 96.4 18.1
EC	341	333	40.4 35.7 - 45.1 44.2	98.4 97.2 - 99.6 11.3	10.3 7.4 - 13.2 27.3	85.6 82.2 - 89 31.6	33.9 29.4 - 38.5 42.6	96 94.1 - 97.9 17.7
FS	144	136	50.3 43.4 - 57.2 41.9	91.4 87.3 - 95.4 23.7	18.2 12.9 - 23.5 32.3	65.2 58.4 - 72 40.2	41.1 34.3 - 47.9 41.2	88.1 83.5 - 92.8 27.3
GP	417	405	63.1 58.5 - 67.8 48.2	99.7 99.2 - 100 5.4	27 22.7 - 31.2 44.3	92.6 90 - 95.2 26.2	51 46.2 - 55.9 49.9	98.7 97.5 - 99.8 11.5
KZ	446	438	50.7 46.5 - 55 45.8	96.4 94.8 - 98 17.2	16.5 13.4 - 19.7 34	79.9 76.4 - 83.4 36.8	41.4 37.2 - 45.6 45.1	95.1 93.2 - 96.9 19.9
MP	154	150	54.7 46.8 - 62.7 49.9	95.4 92 - 98.8 21	17.7 11.6 - 23.8 38.3	59.1 51.1 - 67.1 49.3	48.2 40.2 - 56.2 50.1	94.8 91.2 - 98.4 22.2
NC	43	45	39.8 32 - 47.7 26.1	90.4 85.7 - 95.1 15.9	19 12.7 - 25.3 20.9	71.1 63.9 - 78.3 24.4	31.3 23.9 - 38.9 24.8	89.4 84.5 - 94.3 16.6
LP	239	226	69.4 64.5 - 74.2 38.3	93.4 90.7 - 96.1 20.7	17.4 13.4 - 21.4 31.5	61.5 56.2 - 66.8 40.6	61.2 56 - 66.3 40.5	90.2 87 - 93.5 24.7
NW	177	176	55.7 49.2 - 62.2 43.8	100 - 0	20.7 15.4 - 26 35.7	94.8 91.9 - 97.7 19.5	44.6 38.1 - 51.1 43.8	100 - 0
WC	239	225	74.6 70 - 79.1 35.7	99.6 99 - 100 5	52.2 47 - 57.4 40.9	99.2 98.3 - 100 7.2	48.6 43.4 - 53.8 41	99.2 98.3 - 100 7.2

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape

3.2.9 Frequency of consumption of fruit and vegetables, fruit, and vegetables in RSA

On the basis of the QFFQ, children aged 12 - 108 months in South Africa consumed fruit and vegetables 2.16 times per day [SD 1.52] (n = 2071) on average (Table 3.3). The national mean frequency of fruit intake by children was 0.81 times per day [SD 0.96] (n = 2133) and 1.34 times per day [SD 0.92] (n = 2040) for vegetable intake (Table 3.3).

3.2.10 Frequency of consumption of fruit and vegetables, fruit, and vegetables per province

The Western Cape had the highest mean daily frequency of intake for fruit and vegetables (3.49 times per day [SD 1.75]) (n = 224) as well as for only fruit (1.78 times per day [SD 1.08]) (n = 225) and for only vegetables (1.71 times per day [SD 1.10]) (n = 223). Similarly, children in the Northern Cape had the lowest mean daily frequency of fruit and vegetable intake (1.41 times per day [SD

0.60]) (n = 40), fruit intake (0.5 times per day [SD 0.33]) (n = 45) and vegetable intake (0.87 times per day [SD 0.43]) (n = 40) (Table 3.3).

Table 3.3: Mean daily frequency of intake of fruit and vegetables in children in RSA and per province, as determined by the QFFQ

Region	Fruit and vegetables		Fruit		Vegetables	
	Mean daily intake freq 95% CI SD	N	Mean daily intake freq 95% CI SD	N	Mean daily intake freq 95% CI SD	N
RSA	2.16 2.09 - 2.22 1.52	2071	0.81 0.77 - 0.85 0.96	2133	1.34 1.3 - 1.38 0.92	2040
EC	1.69 1.56 - 1.83 1.24	327	0.59 0.51 - 0.67 0.74	333	1.12 1.04 - 1.21 0.77	319
FS	1.84 1.61 - 2.07 1.3	124	0.53 0.42 - 0.65 0.69	136	1.3 1.13 - 1.47 0.94	120
GP	2.7 2.53 - 2.86 1.7	404	1.16 1.04 - 1.27 1.2	405	1.55 1.46 - 1.65 0.97	400
KZ	1.68 1.56 - 1.8 1.29	422	0.61 0.53 - 0.7 0.9	438	1.06 0.99 - 1.13 0.73	416
MP	2.23 1.93 - 2.54 1.85	143	0.6 0.44 - 0.75 0.98	150	1.62 1.41 - 1.83 1.27	142
NC	1.41 1.22 - 1.6 0.60	40	0.5 0.4 - 0.6 0.33	45	0.87 0.73 - 1 0.43	40
LP	2.14 1.94 - 2.35 1.53	211	0.57 0.46 - 0.68 0.86	226	1.59 1.44 - 1.73 1.03	204
NW	1.60 1.49 - 1.72 0.79	176	0.52 0.46 - 0.58 0.41	176	1.08 1 - 1.17 0.57	176
WC	3.49 3.26 - 3.72 1.75	224	1.78 1.64 - 1.92 1.08	225	1.71 1.57 - 1.86 1.10	223

RSA: Republic of South Africa; EC: Eastern Cape; FS: Free State; GP: Gauteng; KZ: Kwazulu-Natal; MP: Mpumalanga; NC: Northern Cape; LP: Limpopo; NW: North West; WC: Western Cape; freq: frequency

3.3 FRUIT AND VEGETABLE CONSUMPTION ACCORDING TO AGE OF CHILDREN

3.3.1 Daily fruit and vegetable (in grams) consumption per capita per age category

On the basis of the 24-H-RQ, the mean daily intake per capita of fruit and vegetable in children aged 1 - 3 years, 4 - 6 years and 7 - 8.9 years was 96.6 grams [SD 115.9] (n = 795), 105.7 grams [SD 132.4] (n = 861) and 136.9 grams [SD 248.3] (n = 544), respectively (Table 3.4) The mean daily fruit and vegetable intake was 180.2 grams [SD 135.8] (n = 760) in 1 - 3 year old children, 206.2 grams [SD 181.9] (n = 830) in 4 - 6 year old children and 237.4 grams [SD 297.7] (n = 542) in 7 - 8.9 year old children, according to the QFFQ (Table 3.4). The fruit and vegetable intakes increased with each age category.

3.3.2 Daily fruit consumption (in grams) per capita per age category

The mean daily fruit intake was 47.2 grams [SD 94.8] (n = 795) in 1 - 3 year old children, 48 grams [SD 104.6] (n = 861) in 4 - 6 year old children and 74.8 grams [SD 209] (n = 544) in 7 - 8.9 year old children, based on the 24-H-RQ (Table 3.4). According to the QFFQ, the mean daily intake per capita of fruit in children aged 1 - 3 years, 4 - 6 years and 7 - 8.9 years was 98.9 grams [SD 109.8] (n = 760), 113.6 grams [SD 153.5] (n = 830) and 140.6 grams [SD 259.5] (n = 542), respectively (Table 3.4). The fruit consumption increased with each age category.

3.3.3 Daily vegetable consumption (in grams) per capita per age category

Based on the 24-H-RQ, children aged 1 - 3 years had a mean daily vegetable intake of 49.3 grams [SD 65.7] (n = 795), children aged 4 - 6 years ate 57.6 grams [SD 80.8] (n = 861) on average per day and 7 - 8.9 year old children had a mean daily vegetable intake of 62.1 grams [SD 109.2] (n = 544) (Table 3.4). On the basis of the QFFQ, the mean daily intake per capita of vegetables in children aged 1 - 3 years, 4 - 6 years and 7 - 8.9 years was 81.3 grams [SD 65.3] (n = 760), 92.7 grams [SD 76.8] (n = 830) and 96.8 grams [SD 105.1] (n = 544), respectively (Table 3.4). Vegetable intake increased with each age category.

Table 3.4: Mean daily intake per capita (in grams) of fruit and vegetables in children per age category, as determined by the 24-H-RQ and QFFQ

Age category			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (g) 95% CI SD		Mean (g) 95% CI SD		Mean (g) 95% CI SD	
	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
1–3 years	795	760	96.6 88.5 - 104.6 115.9	180.2 170.5 - 189.9 135.8	47.2 40.7 - 53.8 94.8	98.9 91.1 - 106.7 109.8	49.3 44.7 - 53.9 65.7	81.3 76.6 - 85.9 65.3
4–6 years	861	830	105.7 96.8 -114.5 132.4	206.2 193.8 - 218.6 181.9	48 41 - 55 104.6	113.6 103.1 - 124 153.5	57.6 52.2 - 63 80.8	92.7 87.4 - 97.9 76.8
7–8.9 years	544	542	136.9 116 -157.8 248.3	237.4 212.3 - 262.5 297.7	74.8 57.2 - 92.4 209	140.6 118.7 - 162.5 259.5	62.1 52.9 - 71.3 109.2	96.8 88 - 105.7 105.1

3.3.4 Fruit and vegetable consumption and the WHO recommendations

The theoretical-minimum-risk distribution (WHO recommendations) for fruit and vegetable intake (excluding potatoes), estimated by the WHO Comparative Quantification of Health Risks in 2004, was 330 grams per day in children aged 0 - 4 years and 480 grams in children aged 5 - 14 years.[33] The fruit and vegetable intake (Table 3.4) did not meet even the lowest recommendation of 330 grams per day in all of the defined age groups.

3.3.5 Percentage of children consuming fruit and vegetables per age category

The mean percentages of children consuming fruit and vegetables in the age categories, determined by the 24-H-RQ, ranged from 55.3 % [SD 38.8] (n = 795) in the 1 - 3 year olds, 56.4 % [SD 44.2] (n = 861) in the 4 - 6 year olds and 58.6 % [SD 55.6] (n = 544) in the 7 - 8.9 year olds (Table 3.5). Based on the QFFQ, the mean percentages of fruit and vegetable 'eaters' in the age categories were 97.1 % [SD 13] (n = 760) in children aged 1 - 3 years, 97.8 % [SD 13.2] (n = 830) in individuals aged 4 - 6 years and 96.2 % [SD 21.7] (n = 542) in those aged 7 - 8.9 years (Table 3.5). Mean percentages of fruit and vegetable 'eaters' were very similar in the defined age categories, according to both dietary methodologies employed.

3.3.6 Percentage of children consuming fruit per age category

Based on the 24-H-RQ, the mean percentages fruit 'eaters' in the age categories were 21.7 % [SD 32.2] (n = 795) in 1 - 3 year olds, 20.9 % [SD 36.3] (n = 861) in 4 - 6 year olds and 24.4 % [SD 48.5] (n = 544) in 7 - 8.9 year olds (Table 3.5). The QFFQ found that the mean percentage of children who consumed fruit was 81.7 % [SD 30.2] (n = 760), 81.9 % [SD 34.3] (n = 830) and 82.3 % [SD 43.1] (n = 542) in children aged 1 - 3 years, 4 - 6 years and 7 - 8.9 years, respectively (Table 3.5). Mean

percentages of children consuming fruit were very similar in the defined age categories, according to both the 24-H-RQ and QFFQ.

3.3.7 Percentage of children consuming vegetables per age category

The mean percentages of children consuming vegetables in the age categories, determined by the 24-H-RQ, ranged from 44.2 % [SD 38.7] (n = 795) in the 1 - 3 year olds, 46.1 % [SD 44.5] (n = 861) in the 4 - 6 year olds and 46.5 % [SD 56.3] (n = 544) in the 7 - 8.9 year olds (Table 3.5). The mean percentage of vegetable 'eaters' was 94.8 % [SD 17.4] (n = 760), 96.7 % [SD 15.9] (n = 830) and 95.3 % [SD 24] (n = 542) in children aged 1 - 3 years, 4 - 6 years and 7 - 8.9 years, respectively (Table 3.5). Mean percentages of children consuming fruit were very similar in the defined age categories, according to the 24-H-RQ and the QFFQ.

Table 3.5: Mean percentages (%) of children consuming fruit and vegetables per age category, as determined by the 24-H-RQ and QFFQ

Age category			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (%) 95% CI SD		Mean (%) 95% CI SD		Mean (%) 95% CI SD	
	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
1–3 years	795	760	55.3 52.6 - 58 38.8	97.1 96.2 - 98.1 13	21.7 19.5 - 24 32.2	81.7 79.6 - 83.9 30.2	44.2 41.5 - 46.5 38.7	94.8 93.6 - 96 17.4
4–6 years	861	830	56.4 53.4 - 59.3 44.2	97.8 96.9 - 98.7 13.2	20.9 18.5 - 23.4 36.3	81.9 79.6 - 84.2 34.3	46.1 43.1 - 49.1 44.5	96.7 95.6 - 97.8 15.9
7–8.9 years	544	542	58.6 53.9 - 63.3 55.6	96.2 94.3 - 98 21.7	24.4 20.3 - 28.5 48.5	82.3 78.7 - 85.9 43.1	46.5 41.8 - 51.3 56.3	95.3 93.2 - 97.3 24

3.3.8 Frequency of consumption of fruit and vegetables, fruit, and vegetables per age category

The mean daily frequency of intake of fruit and vegetables, fruit, and vegetables, increased slightly with each age category. The mean daily frequencies for all the age categories were comparable to the mean national frequencies for fruit and vegetable intake, fruit intake, and vegetable intake. Mean frequencies for fruit and vegetable intake ranged from 2.06 times per day [SD 1.24] (n = 738) in 1 - 3 year olds, 2.16 times per day [SD 1.54] (n = 812) in 4 - 6 year olds and 2.29 times per day [SD 2.12] (n = 521) in 7 - 8.9 year olds (Table 3.6). For fruit, mean frequencies of intake were 0.78 times per day [SD 0.76] (n = 760) in 1 - 3 year olds, 0.81 times per day [SD 0.99] (n = 830) and 0.86 times per day [SD 1.33] (n = 542) in 7 - 8.9 year olds (Table 3.6). Mean frequencies of vegetable intake for 1 -

3 year olds, 4 - 6 year olds and 7 - 8.9 year olds were 1.29 times per day [SD 0.79] (n = 720), 1.34 times per day [SD 803] (n = 803) and 1.4 times per day [SD 1.23] (n = 517), respectively (Table 3.6).

Table 3.6: Mean daily frequency of intake of fruit and vegetables in children per age category, as determined by the QFFQ

	Fruit and vegetables		Fruit		Vegetables	
Age category	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**
1–3 years	2.06 1.97 - 2.15 1.24	738	0.78 0.72 - 0.83 0.76	760	1.29 1.23 - 1.35 0.79	720
4–6 years	2.16 2.06 - 2.27 1.54	812	0.81 0.75 - 0.89 0.99	830	1.34 1.28 - 1.41 0.92	803
7–8.9 years	2.29 2.11 - 2.47 2.12	521	0.86 0.75 - 0.98 1.33	542	1.4 1.3 - 1.59 1.23	517

3.4 ANTHROPOMETRY

3.4.1 Height-for-age

3.4.1.1 Daily fruit and vegetable consumption (in grams) per capita per height-for-age Z-scores (HAZ)

According to the 24-H-RQ, the mean daily fruit and vegetable intake was 90.9 grams [SD 153.3] (n = 386) in stunted children (HAZ < -2 SD), 114.7 grams [SD 150.2] (n = 1554) in children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) and 97.2 grams [SD 106.1] (n = 54) in children with HAZ > +2 SD (Table 3.7). According to the QFFQ, the mean daily fruit and vegetable intake was 180.8 grams [SD 164.6] (n = 379) in stunted children (HAZ < -2 SD), 214.3 grams [SD 198.4] (n = 1498) in children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) and 189.1 grams [SD 148.3] (n = 54) in children with HAZ > +2 SD (Table 3.7). These mean daily intakes of fruit and vegetables did not differ significantly (Bonferroni p>0.05) according to the height-for-age status of the children. This was true on comparison of the intakes obtained using the 24-H-RQ as well as for comparisons of the mean intakes as measured by the QFFQ.

3.4.1.2 Daily fruit consumption (in grams) per capita per height-for-age Z-scores (HAZ)

The mean daily fruit intake was 39.6 grams [SD 127.5] (n = 386) in stunted children (HAZ < -2 SD), 57.8 grams [SD 122.7] (n = 1554) in children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD)

and 54.8 grams [SD 93.3] (n = 54) in children with HAZ > +2 SD, as measured by the 24-H-RQ (Table 3.7). The QFFQ quantified the mean daily fruit intake at 94.8 grams [SD 134.1] (n = 379) in stunted children (HAZ < -2 SD), 123.3 grams [SD 169.8] (n = 1498) in children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) and 96.6 grams [SD 119.5] (n = 54) in children with HAZ > +2 SD (Table 3.7). Mean daily consumption of fruit per capita (in grams), did not differ significantly (Bonferroni p>0.05) according to the height-for-age status of the children. This was the case when comparing the values obtained with the 24-H-RQ and when comparing the measurements acquired using the QFFQ.

3.4.1.3 Daily vegetable consumption (in grams) per capita per height-for-age Z-scores (HAZ)

The 24-H-RQ measured the mean daily vegetable intake at 51.3 grams [SD 72.9] (n = 386) in stunted children (HAZ < -2 SD), 56.9 grams [SD 82.3] (n = 1554) in children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) and 42.4 grams [SD 57.5] (n = 54) in children with HAZ > +2 SD (Table 3.7). According to the QFFQ, the mean daily vegetable intake was 86 grams [SD 68.9] (n = 379) in stunted children (HAZ < -2 SD), 90.9 grams [SD 79.4] (n = 1498) in children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) and 92.5 grams [SD 84.9] (n = 54) in children with HAZ > +2 SD (Table 3.7). The mean daily vegetable intake by children per capita, also did not differ significantly (Bonferroni p>0.05) according to the children's height-for-age status, on comparison of the 24-H-RQ measurements and on comparison of the QFFQ values.

Table 3.7: Mean daily intake per capita (in grams) of fruit and vegetables in children per height-for-age Z-scores (HAZ), as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (g) 95% CI SD		Mean (g) 95% CI SD		Mean (g) 95% CI SD	
HAZ	**N**	**N**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**
< -2 SD	386	379	90.9 75.6 - 106.2 153.3	180.8 164.2 - 197.5 164.6	39.6 26.9 - 52.4 127.5	94.8 81.3 - 108.4 134.1	51.3 44 - 58.6 72.9	86 79.1 - 93 68.9
≥ -2 SD ≤ +2 SD	1554	1498	114.7 107.2 - 122.2 150.2	214.3 204.2 - 224.3 198.4	57.8 51.7 - 63.9 122.7	123.3 114.7 - 131.9 169.8	56.9 52.8 - 61 82.3	90.9 86.9 - 95 79.4
> +2 SD	54	54	97.2 68.5 - 126 106.1	189.1 148.9 - 229.3 148.3	54.8 29.5 - 80.1 93.3	96.6 64.2 - 129 119.5	42.4 26.8 - 58 57.5	92.5 69.5 - 115.5 84.9

3.4.1.4 Daily energy intake (in kilojoules) per capita per height-for-age Z-scores (HAZ)

The mean daily energy intake of children that were not stunted (HAZ ≥ -2 SD) was significantly greater (Wilcoxon two-sample test) (t approximation p<0.0001) than the mean energy intake of stunted children (HAZ < -2 SD) on analysis of the 24-H-RQ data and on analysis of the QFFQ data (Table 3.8).

Table 3.8: Mean daily energy intake per capita (in kilojoules (kJ)) in children per height-for-age Z-scores (HAZ), as determined by the 24-H-RQ and QFFQ

			Energy intake	
	24-H-RQ	QFFQ	Mean (kJ) 95% CI SD	
HAZ	N	N	24-H-RQ	QFFQ
< -2 SD	386	373	4438 4272 - 4604 1659	6137 5871 - 6403 2615
≥ -2 SD	1608	1543	5162* 5061 - 5263 2064	7031** 6878 - 7185 3075

* significantly greater than HAZ < -2 SD, Wilcoxon Two-sample test, t approximation p<0.0001
******significantly greater than HAZ < -2 SD, Wilcoxon Two-sample test, t approximation p<0.0001

3.4.1.5 Percentage of children consuming fruit and vegetables ('eaters') per height-for-age Z-scores (HAZ)

The mean percentages of 'eaters' of fruit and vegetables obtained using the 24-H-RQ, were very similar among stunted children (HAZ < -2 SD), children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) and children with HAZ > +2 SD and no significant (Bonferroni p>0.05) differences were found between these percentages (Table 3.9). This was also true for the mean percentages of fruit and vegetable 'eaters' obtained using the QFFQ, although, as expected, these percentages were higher (Table 3.9).

3.4.1.6 Percentage of children consuming fruit ('eaters') per height-for-age Z-scores (HAZ)

The 24-H-RQ found that a significantly lower (Bonferroni p<0.05) percentage of stunted children (HAZ < -2 SD) (16.8 % [SD 31.3]) (n = 386) consumed fruit than children with a HAZ > +2 SD (30.6 % [SD 40.5]) (n = 54) (Table 3.9; Figure 3.7). The analysis of the QFFQ data showed no significant differences (Bonferroni p>0.05) between the percentages of fruit 'eaters', among stunted children (HAZ < -2 SD) (78.5 % [SD 34.5]) (n = 379), children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) (83.6 % [SD 33.3]) (n = 1498) and children with HAZ > +2 SD (78.1 % [SD 36.6]) (n = 54) (Table 3.9; Figure 3.7).

Figure 3.7: Mean percentages of children consuming fruit (Fruit eaters) per height-for-age Z-scores (HAZ), as determined by the 24-H-RQ and QFFQ

3.4.1.7 Percentage of children consuming vegetables ('eaters') per height-for-age Z-scores (HAZ)

On comparison of the 24-H-RQ data, the mean percentages of vegetable 'eaters' did not differ significantly (Bonferroni p>0.05) among stunted children (HAZ < -2 SD) (41.3 % [SD 41.2]) (n = 386), children with a normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) (46.7 % [SD 44.8]) (n = 1554) and children with HAZ > +2 SD (44.3 % [SD 43.7]) (n = 54) (Table 3.9). This was also found on comparison of the QFFQ data, with mean percentages of vegetable 'eaters' being 95.8 % [SD 16.9] (n = 379) in stunted children (HAZ < -2 SD), 95.6 % [SD 18.4] (n = 1498) in children with normal height-for-age (≤ +2 SD HAZ ≥ -2 SD) and 98.6 % [SD 10.3] (n = 54) in children with HAZ > +2 SD (Table 3.9).

Table 3.9: Mean percentages (%) of children consuming fruit and vegetables per height-for-age Z-scores (HAZ), as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (%) 95% CI SD		Mean (%) 95% CI SD		Mean (%) 95% CI SD	
HAZ	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
< -2 SD	386	379	53.4 49.3 - 57.6 41.7	97.2 95.8 - 98.6 13.9	16.8* 13.7 - 19.9 31.3	78.5 75 - 82 34.5	41.3 37.2 - 45.5 41.2	95.8 94.1 97.5 16.9
≥ -2 SD ≤ +2 SD	1554	1498	57.6 55.4 - 59.8 44.4	97.2 96.4 - 97.9 15	23.2 21.3 - 25.1 37.9	83.6 81.9 - 85.3 33.3	46.7 44.5 - 48.9 44.8	95.6 94.7 - 96.6 18.4
> +2 SD	54	54	58.9 47.2 - 70.7 43.3	99.7 98.4 - 100 4.8	30.6 19.6 - 41.6 40.5	78.1 68.2 - 88 36.6	44.3 32.5 - 56.2 43.7	98.6 95.9 - 100 10.3

* significantly lower (Bonferroni p<0.05) than > +2 SD HAZ

3.4.1.8 Frequency of consumption of fruit and vegetables, of fruit, and of vegetables per height-for-age Z-scores (HAZ)

The mean daily frequency of intake of fruit and vegetables, of fruit, and of vegetables by children did not differ significantly (Bonferroni p>0.05), according to their height-for-age status (Table 3.10).

Table 3.10: Mean daily frequency of intake of fruit and vegetables in children per height-for-age Z-scores (HAZ), as determined by the QFFQ

	Fruit and vegetables		Fruit		Vegetables	
HAZ	Mean daily intake freq 95% CI SD	N	Mean daily intake freq 95% CI SD	N	Mean daily intake freq 95% CI SD	N
< -2 SD	1.94 1.80 - 2.08 1.33	368	0.69 0.60 - 0.77 0.84	379	1.25 1.17 - 1.34 0.81	363
≥ -2 SD ≤ +2 SD	2.23 2.15 - 2.32 1.59	1455	0.86 0.81 - 0.91 1.00	1498	1.37 1.32 - 1.42 0.96	1432
> +2 SD	2.07 1.71 - 2.42 1.30	54	0.74 0.52 - 0.95 0.79	54	1.34 1.11 - 1.57 0.85	53

3.4.2 Weight-for-age

3.4.2.1 Daily fruit and vegetable consumption (in grams) per capita per weight-for-age Z-scores (WAZ)

The 24-H-RQ found the greatest average daily intake per capita of fruit and vegetables in overweight children (WAZ > +2 SD) at 137.2 grams [SD 161.2] (n = 74) and the smallest mean intake in underweight children (WAZ < -2 SD) at 96.7 grams [SD 120.6] (n = 172). However, the mean intakes by children with different weight-for-age Z-scores, did not differ significantly (Bonferroni p>0.05) from each other (Table 3.11; Figure 3.8). The analyses of the QFFQ data revealed that the mean intake of fruit and vegetables by underweight children (WAZ < -2 SD) (172.4 grams [SD 166.4]) (n = 171) and children with a normal weight-for-age (≤ +2 SD WAZ ≥ -2 SD) (206.3 grams [SD 188]) (n = 1689), was significantly lower (Bonferroni p<0.05) than by overweight children (WAZ > +2 SD) (306.8 grams [SD 279.9]) (n = 71) (Table 3.11; Figure 3.8).

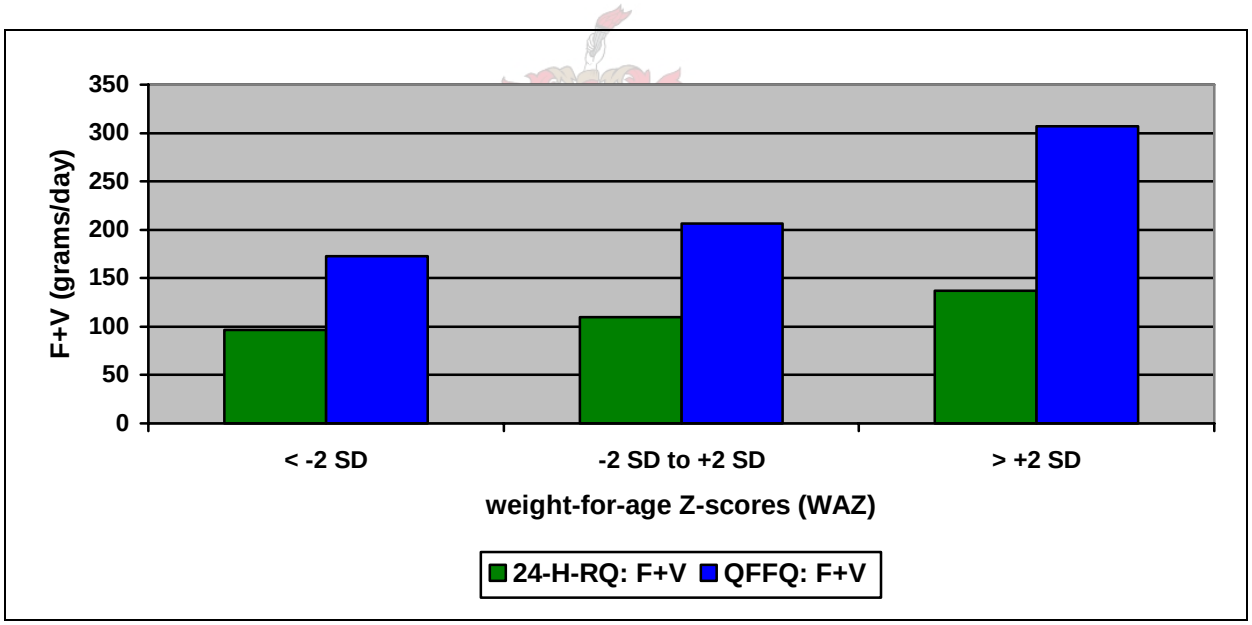

Figure 3.8: Mean daily intake per capita (in grams) of fruit and vegetables (F+V) in children per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

3.4.2.2 Daily fruit consumption (in grams) per capita per weight-for-age Z-scores (WAZ)

The 24-H-RQ data analyses showed that underweight children (WAZ < -2 SD) (33.8 grams [SD 78.8]) (n = 172) consumed significantly less (Bonferroni p<0.05) fruit than overweight children (WAZ > +2 SD) (76.8 grams [SD 143.6]) (n = 74). (Table 3.11; Figure 3.9) According to the QFFQ data analyses, underweight children (WAZ < -2 SD) (86.7 grams [SD 131.7]) (n = 171) and children with a

normal weight-for-age (≤ +2 SD WAZ ≥ -2 SD) (117.4 grams [SD 161.7]) (n = 1689), had a significantly lower (Bonferroni p<0.05) mean intake of fruit than overweight children (WAZ > +2 SD) (179.9 grams [SD 220.8]) (n = 71) (Table 3.11; Figure 3.9).

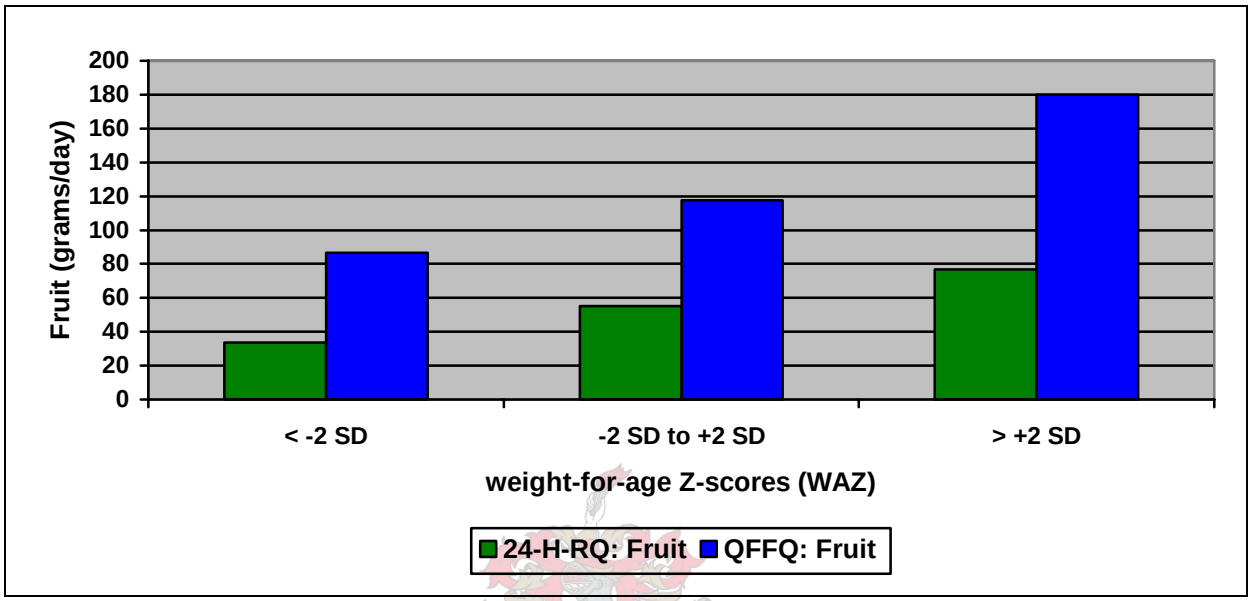

Figure 3.9: Mean daily intake per capita (in grams) of fruit in children per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

3.4.2.3 Daily vegetable consumption (in grams) per capita per weight-for-age Z-scores (WAZ)

The 24-H-RQ data analyses showed that the children's mean intakes of vegetables did not differ significantly (Bonferroni p>0.05) according to their weight-for-age (Table 3.11; Figure 3.10). According to the QFFQ measurements, underweight children (WAZ < -2 SD) (85.7 grams [SD 75.1] (n = 171) and children with a normal weight-for-age (≤ +2 SD WAZ ≥ -2 SD) (88.9 grams [SD 74]) (n = 1689) had a significantly lower (Bonferroni p<0.05) mean intake per day of vegetables than overweight children (126.9 grams [SD 138.5]) (n = 71) (Table 3.11; Figure 3.10).

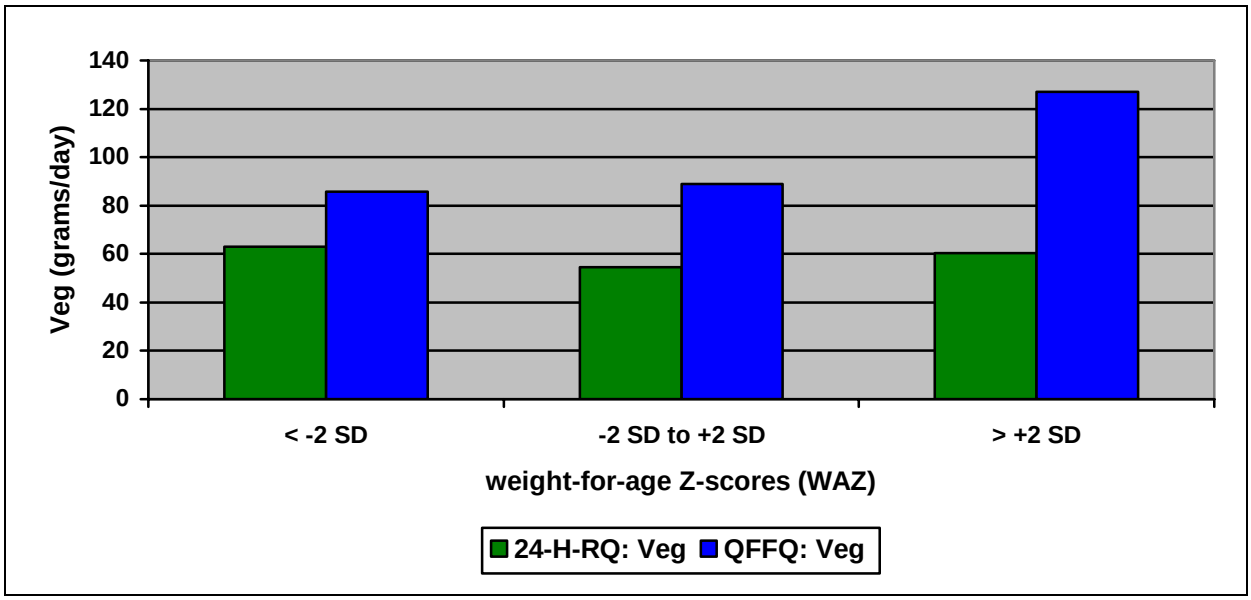

Figure 3.10: Mean daily intake per capita (in grams) of vegetables (Veg) in children per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

Table 3.11: Mean daily intake per capita (in grams) of fruit and vegetables in children per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (g) 95% CI SD		Mean (g) 95% CI SD		Mean (g) 95% CI SD	
WAZ	**N**	**N**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**
< -2 SD	172	171	96.7 78.6 - 114.8 120.6	172.4* 147.3 - 197.5 166.4	33.8* 22 - 45.6 78.8	86.7* 66.8 - 106.5 131.7	62.9 49.1 - 76.6 91.5	85.7* 74.4 - 97 75.1
≥ -2 SD ≤ +2 SD	1747	1689	109.7 102.6 - 116.9 152.6	206.3* 197.3 - 215.3 188	55.2 49.3 - 61.2 126.4	117.4* 109.7 - 125.1 161.7	54.5 50.8 - 58.2 78.4	88.9* 85.4 - 92.4 74
> +2 SD	74	71	137.2 100.1 - 174.4 161.2	306.8 241 - 372.7 279.9	76.8 43.7 - 109.9 143.6	179.9 127.9 - 231.9 220.8	60.4 42.9 - 78 76.2	126.9 94.3 - 159.5 138.5

* significantly lower (Bonferroni p<0.05) than > +2 SD WAZ

3.4.2.4 Daily energy intake (in kilojoules) per capita per weight-for-age Z-scores (WAZ)

The mean daily energy intake of children that were not underweight (WAZ ≥ -2 SD) was significantly higher (Wilcoxon two-sample test) (t approximation p<0.0001) than the mean energy intake of underweight children (WAZ < -2 SD) on analysis of the 24-H-RQ data and on analysis of the QFFQ data (Table 3.12).

Table 3.12: Mean daily energy intake per capita (in kilojoules (kJ)) in children per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

			Energy intake	
	24-H-RQ	QFFQ	Mean (kJ) 95% CI SD	
WAZ	**N**	**N**	**24-H-RQ**	**QFFQ**
< -2 SD	172	167	4380 4121 - 4639 1727	5983 5612 - 6354 2433
≥ -2 SD	1747	1678	5082* 4990 - 5175 2020	6940** 6798 - 7083 3044

* significantly greater than WAZ < -2 SD, Wilcoxon Two-sample test, t approximation p<0.0001
** significantly greater than WAZ < -2 SD, Wilcoxon Two-sample test, t approximation p<0.0001

3.4.2.5 Percentage of children consuming fruit and vegetables ('eaters') per weight-for-age Z-scores (WAZ)

The mean percentages of 'eaters' of fruit and vegetables measured using the 24-H-RQ, were similar among underweight children (WAZ < -2 SD), children with a normal weight-for-age (≤ +2 SD WAZ ≥ -2 SD) and overweight children (WAZ > +2 SD), and no significant (Bonferroni p>0.05) differences were found between these percentages (Table 3.13; Figure 3.11). On analysis of the QFFQ data, the percentage of 'eaters' of fruit and vegetables amongst underweight children (WAZ < -2 SD) (94.6 % [SD 18.5]) (n = 171) was significantly lower (Bonferroni p<0.05) than the percentage of fruit and vegetable 'eaters' amongst overweight children (WAZ > +2 SD) (99.8 % [SD 4.4]) (n = 71) (Table 3.13; Figure 3.11).

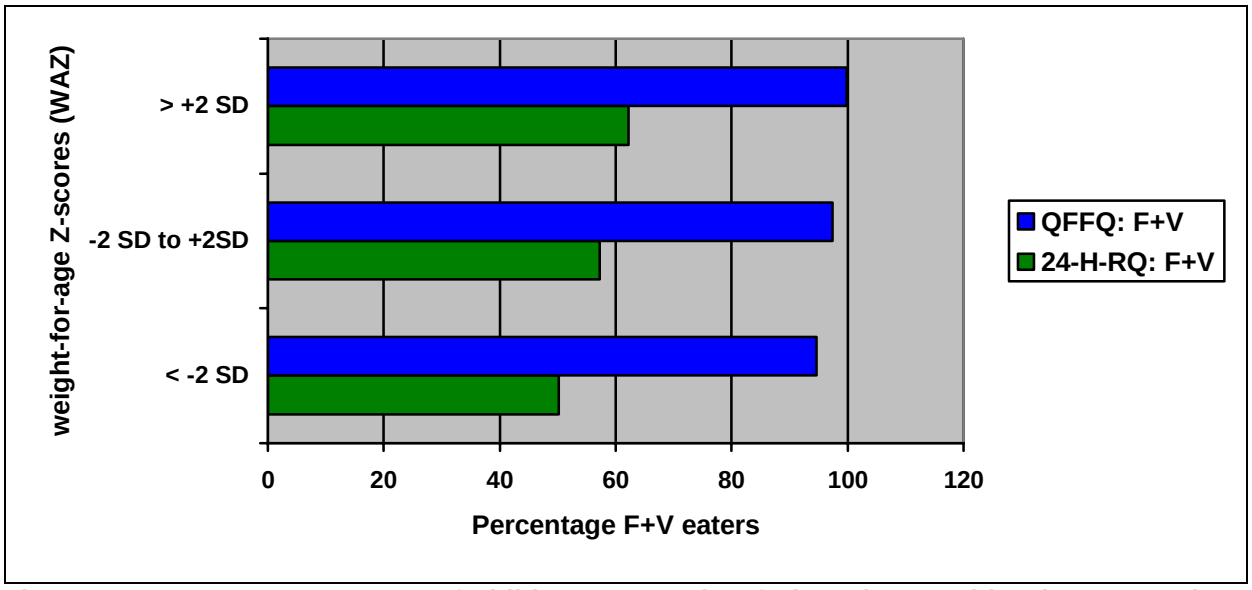

Figure 3.11: Mean percentages of children consuming fruit and vegetables (F+V eaters) per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

3.4.2.6 Percentage of children consuming fruit ('eaters') per weight-for-age Z-scores (WAZ)

A significantly lower percentage of underweight children (WAZ < -2 SD) (16.4 % [SD 30.1]) (n = 172) consumed fruit than overweight children (WAZ > +2 SD) (29 % [SD 42.5]) (n = 74), according to 24-H-RQ analyses (Table 3.13; Figure 3.12). The QFFQ analyses found that the mean percentages of children consuming fruit did not differ significantly (Bonferroni p>0.05) amongst children with different WAZ (Table 3.13; Figure 3.12).

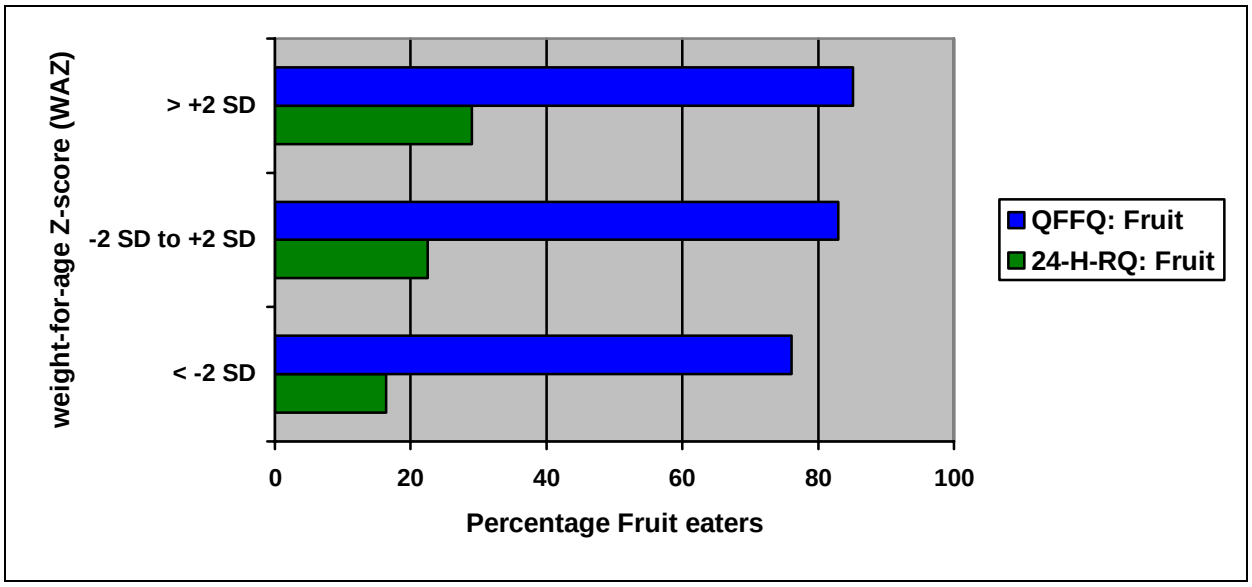

Figure 3.12: Mean percentages of children consuming fruit (Fruit eaters) per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

3.4.2.7 Percentage of children consuming vegetables ('eaters') per weight-for-age Z-scores (WAZ)

According to the 24-H-RQ measurements, there were no significant (Bonferroni $p>0.05$) differences between the mean percentages of vegetable 'eaters', when comparing these percentages in underweight children (WAZ < -2 SD), children with a normal weight-for-age (≤ +2 SD WAZ ≥ -2 SD) and overweight children (WAZ > +2 SD) (Table 3.13; Figure 3.13). On analysis of the QFFQ data, the percentage of vegetable 'eaters' amongst underweight children (WAZ < -2 SD) (93.5 % [SD 20.2]) (n = 171) was significantly lower (Bonferroni $p<0.05$) than the percentage of vegetable 'eaters' amongst overweight children (WAZ > +2 SD) (99.8 % [SD 4.5]) (n = 71) (Table 3.13; Figure 3.13).

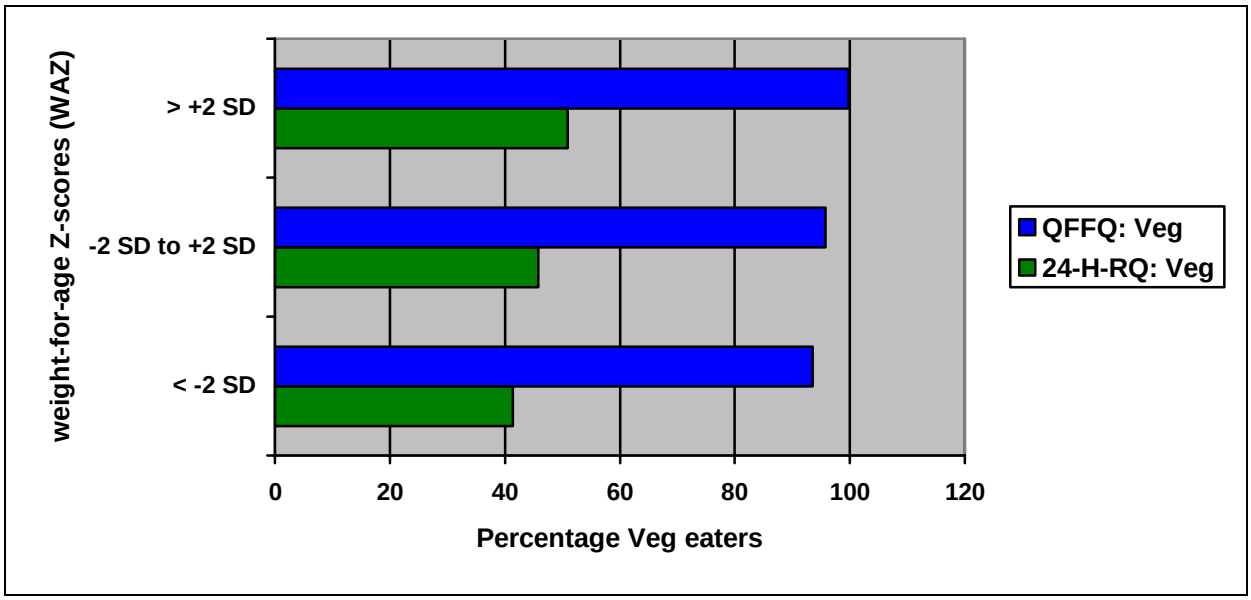

Figure 3.13: Mean percentages of children consuming vegetables (Veg eaters) per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

Table 3.13: Mean percentages (%) of children consuming fruit and vegetables per weight-for-age Z-scores (WAZ), as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (%) 95% CI SD		Mean (%) 95% CI SD		Mean (%) 95% CI SD	
WAZ	**N**	**N**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**
< -2 SD	172	171	50.2 44.1 - 56.3 40.7	94.6* 91.9 - 97.4 18.5	16.4* 11.8 - 20.9 30.1	76.1 70.8 - 81.4 35	41.4 35.4 - 47.4 40.1	93.5* 90.4 96.5 20.2
≥ -2 SD ≤ +2 SD	1747	1689	57.2 55.2 - 59.3 44.1	97.4 96.7 - 98.1 14.3	22.5 20.7 - 24.2 37.2	83 81.4 - 84.6 33.5	45.8 43.7 - 47.9 44.4	95.8 94.9 - 96.4 17.9
> +2 SD	74	71	62.2 51.7 - 72.6 45.4	99.8 98.7 - 100 4.4	29 19.2 - 38.8 42.5	85.1 77.2 - 93 33.4	50.9 40.1 - 61.6 46.8	99.8 98.7 - 100 4.5

* significantly lower (Bonferroni p<0.05) than > +2 SD WAZ

3.4.2.8 Frequency of consumption of fruit and vegetables per weight-for-age Z-scores (WAZ)

The mean daily frequency of intake of fruit and vegetables by underweight children (WAZ < -2 SD) (1.85 times per day [SD 1.30]) (n = 162) was significantly lower (Bonferroni p<0.05) than that of overweight children (WAZ > +2 SD) (2.94 times per day [SD 1.91]) (n = 71) (Table 3.14).

3.4.2.9 Frequency of consumption of fruit and of vegetables per weight-for-age Z-scores (WAZ)

Underweight children (WAZ < -2 SD) (0.58 times per day [SD 0.75]) (n = 171) and children with a normal weight-for-age (≤ +2 SD WAZ ≥ -2 SD) (0.83 times per day [SD 1.27]) (n = 1689) had a significantly lower (Bonferroni p<0.05) mean daily frequency of fruit intake than overweight children (WAZ > +2 SD) (1.27 times per day [SD 1.31]) (n = 71) (Table 3.14). The mean daily frequency of vegetable consumption by underweight children (WAZ < -2 SD) (1.25 times per day [SD 0.84]) (n = 160) and children with a normal weight-for-age (≤ +2 SD WAZ ≥ -2 SD) (1.34 times per day [SD 0.93]) (n = 1618) was significantly lower (Bonferroni p<0.05) than the frequency of vegetable intake by overweight children (WAZ > +2 SD) (1.66 times per day [SD 1.06]) (n = 71) (Table 3.14).

Table 3.14: Mean daily frequency of intake of fruit and vegetables in children per weight-for-age Z-scores (WAZ), as determined by the QFFQ

	Fruit and vegetables		Fruit		Vegetables	
WAZ	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**
< -2 SD	1.85* 1.65 - 2.05 1.30	162	0.58* 0.47 - 0.70 0.75	171	1.25* 1.12 - 1.38 0.84	160
≥ -2 SD ≤ +2 SD	2.17 2.10 - 2.24 1.53	1644	0.83* 0.78 - 0.88 0.97	1689	1.34* 1.29 - 1.39 0.93	1618
> +2 SD	2.94 2.49 - 3.39 1.91	71	1.27 0.97 - 1.58 1.31	71	1.66 1.41 - 1.91 1.06	71

* significantly lower (Bonferroni p<0.05) than > +2 SD WAZ

3.4.3 Weight-for height

3.4.3.1 Daily fruit and vegetable consumption (in grams) per capita per weight-for-height Z-scores (WHZ)

The mean daily intakes of fruit and vegetables, measured by the 24-H-RQ, were similar in wasted children (WHZ < -2 SD), in children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and in overweight children (WHZ > +2 SD) and these values did not differ significantly (Bonferroni p>0.05) from each other (Table 3.15; Figure 3.14). On analysis of the QFFQ data, the mean daily consumption of fruit and vegetables by wasted children (WHZ < -2 SD) (147.4 grams [SD 146.9]) (n = 62) was significantly lower than the mean consumption by children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) (206.6 grams [SD 189]) (n = 1743) and by overweight children (WHZ > +2 SD) (242.6 grams [SD 228.1]) (n = 126) (Table 3.15; Figure 3.14).

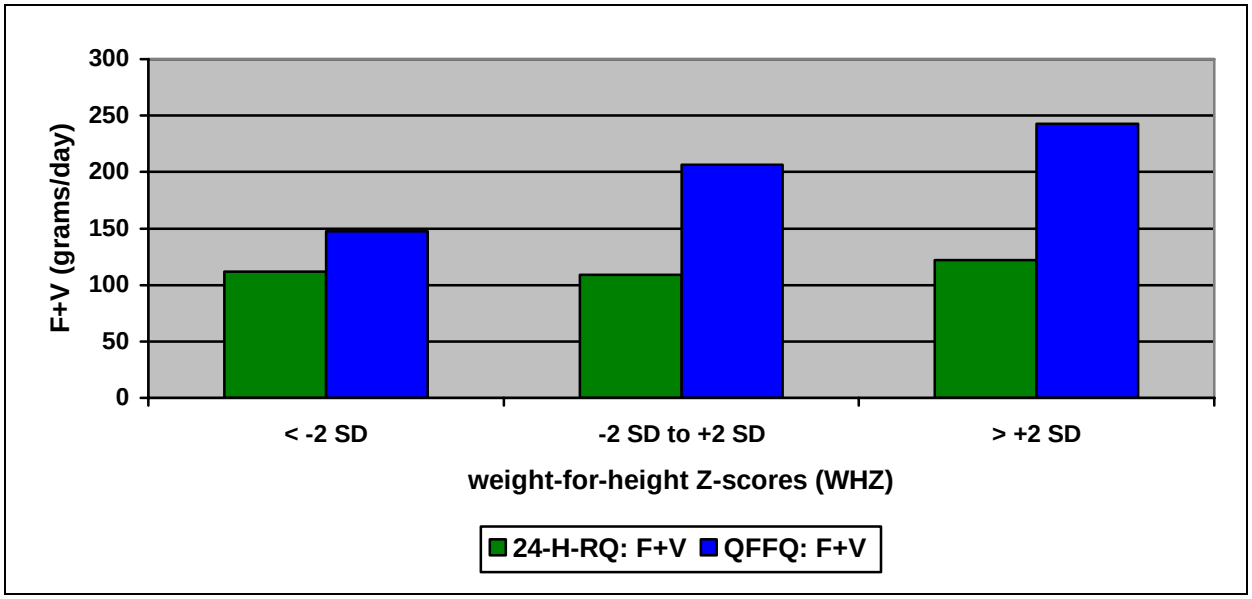

Figure 3.14: Mean daily intake per capita (in grams) of fruit and vegetables (F+V) in children per weight-for-height Z-scores (WHZ), as determined by the 24-H-RQ and QFFQ

3.4.3.2 Daily fruit consumption (in grams) per capita per weight-for-height Z-scores (WHZ)

The mean daily intakes of fruit by wasted children (WHZ < -2 SD), by children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and by overweight children (WHZ > +2 SD), as measured by the 24-H-RQ, did not differ significantly (Bonferroni $p>0.05$) (Table 3.15; Figure 3.15). However, wasted children (WHZ < -2 SD) had a significantly lower (Bonferroni $p<0.05$) mean fruit intake (75.8 grams [SD 117.6]) (n = 62) than overweight children (> +2 SD WHZ) (136.1 grams [SD 187.8]) (n = 126), according to QFFQ analyses (Table 3.15; Figure 3.15).

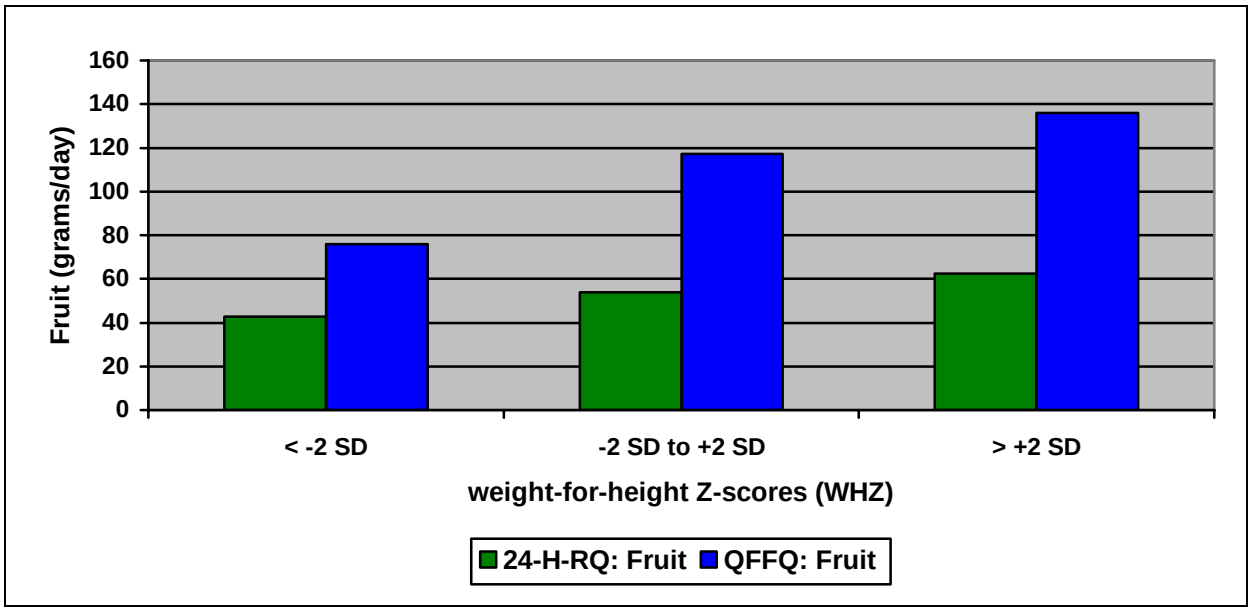

Figure 3.15: Mean daily intake per capita (in grams) of fruit in children per weight-for-height Z-scores (WHZ), as determined by the 24-H-RQ and QFFQ

3.4.3.3 Daily vegetable consumption (in grams) per capita per weight-for-height Z-scores (WHZ)

According to the 24-H-RQ measurements, there were no significant (Bonferroni $p>0.05$) differences between the mean daily consumption of vegetables, when comparing the intakes by wasted children (WHZ < -2 SD), by children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and by overweight children (WHZ > +2 SD) (Table 3.15; Figure 3.16). According to QFFQ data analyses, wasted children (WHZ < -2 SD) (71.1 grams [SD 75.7]) (n = 62) had a significantly lower (Bonferroni $p<0.05$) mean vegetable intake than overweight children (WHZ > +2 SD) (106.5 grams [SD 89.2]) (n = 126) (Table 3.15; Figure 3.16).

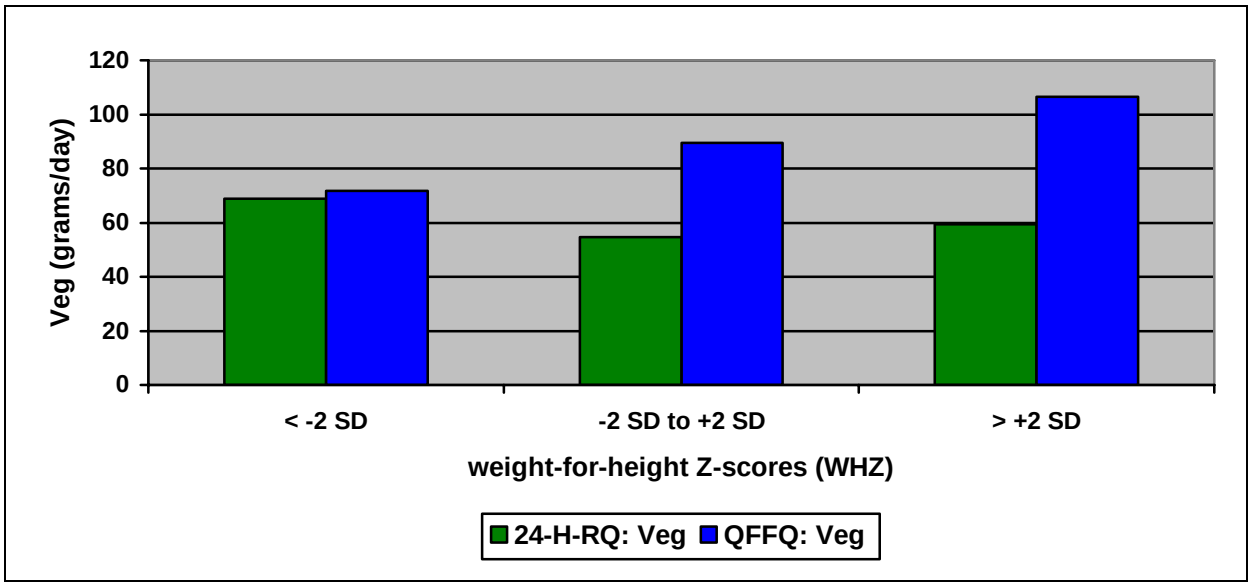

Figure 3.16: Mean daily intake per capita (in grams) of vegetables (Veg) in children per weight-for-height Z-scores (WHZ), as determined by the 24-H-RQ and QFFQ

Table 3.15: Mean daily intake per capita (in grams) of fruit and vegetables in children per weight-for-height Z-scores (WHZ), as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (g) 95% CI SD		Mean (g) 95% CI SD		Mean (g) 95% CI SD	
WHZ	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
< -2 SD	64	62	111.7 81.2 - 142.3 123	147.4** 110.4 - 184.5 146.9	42.9 21.8 - 64 85	75.8* 46.1 105.4 117.6	68.8 49.5 - 88.2 78	71.7* 52.6 - 90.8 75.7
≥ -2 SD ≤ +2 SD	1797	1743	108.7 101.7 - 115.6 151	206.6 197.7 - 215.4 189	54 48.3 - 59.7 124	117.1 109.5 - 124.6 161.2	54.7 50.9 - 58.4 80.3	89.5 85.9 93.1 76.5
> +2 SD	132	126	121.7 95.8 - 147.6 150.7	242.6 202.4 - 282.7 228.1	62.4 40.2 - 84.6 129.4	136.1 103 - 169.2 187.8	59.3 46.9 - 71.6 71.9	106.5 90.7 - 122.2 89.2

* significantly lower (Bonferroni p<0.05) than > +2 SD WHZ
** significantly lower than > +2 SD and ≥ -2 SD ≤ +2 SD WHZ

3.4.3.4 Daily energy intake (in kilojoules) per capita per weight-for-height Z-scores (WHZ)

On analysis of the 24-H-RQ data, the mean daily energy intake of children that were not wasted (WHZ ≥ -2 SD) was significantly greater (Wilcoxon two-sample test) (t approximation p=0.0131) than the mean energy intake of wasted children (WHZ < -2 SD) (Table 3.16). Similarly, an analysis of the QFFQ data, children that were not wasted (WHZ ≥ -2 SD) had a significantly greater (Wilcoxon two-

sample test) (t approximation p<0.0001) mean energy intake than wasted children (WHZ < -2 SD) (Table 3.16).

Table 3.16: Mean daily energy intake per capita (in kilojoules (kJ)) in children per weight-for-height Z-scores (WHZ), as determined by the 24-H-RQ and QFFQ

			Energy intake	
	24-H-RQ	QFFQ	Mean (kJ) 95% CI SD	
WHZ	N	N	24-H-RQ	QFFQ
< -2 SD	64	62	4690 4194 - 5185 1998	5476 4820 - 6132 2601
≥ -2 SD	1930	1854	5033* 4944 - 5122 1999	6903** 6767 - 7040 3002

* significantly greater than WHZ < -2 SD, Wilcoxon Two-sample test, t approximation p=0.0131
** significantly greater than WHZ < -2 SD, Wilcoxon Two-sample test, t approximation p<0.0001

3.4.3.5 Percentage of children consuming fruit and vegetables ('eaters') per weight-for-height Z-scores (WHZ)

According to the 24-H-RQ measurements, there were no significant (Bonferroni p>0.05) differences between the mean percentages of fruit and vegetable 'eaters', when comparing these percentages in wasted children (WHZ < -2 SD), children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and overweight children (WHZ > +2 SD) (Table 3.17). There were also no significant (Bonferroni p>0.05) differences found on comparison of mean percentages of fruit and vegetable 'eaters' in wasted children (WHZ < -2 SD), children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and overweight children (WHZ > +2 SD), according to measurements by the QFFQ (Table 3.17).

3.4.3.6 Percentage of children consuming fruit ('eaters') per weight-for-height Z-scores (WHZ)

The mean percentages of fruit 'eaters' did not differ significantly (Bonferroni p>0.05) between wasted children (WHZ < -2 SD), children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and overweight children (WHZ > +2 SD) weight-for-height Z-score categories, on analysis of 24-H-RQ data (Table 3.17; Figure 3.17). QFFQ data analyses, however, showed a significantly lower (Bonferroni p<0.05) percentage of fruit 'eaters' amongst wasted children (< -2 SD WHZ) (66.6 % [SD 39.6]) (n = 62) than amongst children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) (83.1 % [SD 33.2]) (n = 1743) and overweight children (WHZ > +2 SD) (81 % [SD 36.5]) (n = 126) (Table 3.17; Figure 3.17).

Figure 3.17: Mean percentages of children consuming fruit per weight-for-height Z-scores (WHZ), as determined by the 24-H-RQ and QFFQ

3.4.3.7 Percentage of children consuming vegetables ('eaters') per weight-for-height Z-scores (WHZ)

There were no significant (Bonferroni p>0.05) differences between the mean percentages vegetable 'eaters', obtained using the 24-H-RQ, when comparing these percentages in wasted children (WHZ < -2 SD), children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and overweight children (WHZ > +2 SD) (Table 3.17). According to the QFFQ measurements, there were also no significant (Bonferroni p>0.05) differences found on comparison of mean percentages of fruit and vegetable 'eaters' in wasted children (WHZ < -2 SD), children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and overweight children (WHZ > +2 SD) (Table 3.14).

Table 3.17: Mean percentages (%) of children consuming fruit and vegetables per weight-for-height Z-scores (WHZ), as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (%) 95% CI SD		Mean (%) 95% CI SD		Mean (%) 95% CI SD	
WHZ	**N**	**N**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**
< -2 SD	67	62	58.3 48 - 68.5 41.4	93.5 88.3 - 98.7 20.7	23.6 14.8 - 32.5 35.7	66.6** 56.6 - 76.6 39.6	48.5 38.1 - 58.9 41.9	93.1 87.8 - 98.5 21.2
≥ -2 SD ≤ +2 SD	1797	1743	56.3 54.3 - 58.4 43.8	97.4 96.7 - 98 14.2	21.9 20.2 - 23.6 36.5	83.1 81.6 - 84.7 33.2	45.1 43.1 - 47.1 44	95.8 95 - 96.6 17.7
> +2 SD	132	126	62.6 54.9 - 70.3 44.9	96.9 94.1 - 99.7 16	25.4 18.4 - 32.3 40.3	81 74.6 - 87.4 36.5	51.1 43.2 - 59.3 46.4	95.9 92.7 - 99.1 18.4

** significantly lower than > +2 SD and ≥ -2 SD ≤ +2 SD WHZ

3.4.3.8 Frequency of consumption of fruit and vegetables per weight-for-height Z-scores (WHZ)

The mean daily frequency of intake of fruit and vegetables by wasted children (WHZ < -2 SD) (1.51 times per day [SD 1.05]) (n = 58) was significantly lower (Bonferroni p<0.05) than that of children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) (2.17 times per day [SD 1.52]) (n = 1697) and overweight children (WHZ > +2 SD) (2.57 times per day [SD 1.77]) (n = 122) (Table 3.18).

3.4.3.9 Frequency of consumption of fruit and of vegetables per weight-for-height Z-scores (WHZ)

The mean daily frequency of fruit consumption by wasted children (WHZ < -2 SD) (0.47 times per day [SD 0.56]) (n = 62) was significantly lower (Bonferroni p<0.05) than that of children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) (0.83 times per day [SD 0.97]) (n = 1743) and overweight children (WHZ > +2 SD) (0.95 times per day [SD 1.10]) (n = 126) (Table 3.18). The mean daily frequency of vegetable consumption by wasted children (WHZ < -2 SD) (1.01 times per day [SD 0.76]) (n = 58) was significantly lower (Bonferroni p<0.05) than that of children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) (1.34 times per day [SD 0.92]) (n = 1670) and overweight children (WHZ > +2 SD) (1.60 times per day [SD 1.05]) (n = 121) (Table 3.18).

Table 3.18: Mean daily frequency of intake of fruit and vegetables in children per weight-for-height Z-scores (WHZ), as determined by the QFFQ

	Fruit and vegetables		Fruit		Vegetables	
WHZ	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**
< -2 SD	1.51** 1.24 - 1.78 1.05	58	0.47** 0.33 - 0.61 0.56	62	1.01** 0.81 – 1.21 0.76	58
≥ -2 SD ≤ +2 SD	2.17 2.09 - 2.24 1.52	1697	0.83 0.78 - 0.87 0.97	1743	1.34 1.29 - 1.38 0.92	1670
> +2 SD	2.57 2.25 - 2.89 1.77	122	0.95 0.77 – 1.15 1.10	126	1.60 1.41 – 1.79 1.05	121

** significantly lower than > +2 SD and ≥ -2 SD ≤ +2 SD WHZ

3.5 FRUIT AND VEGETABLE CONSUMPTION AND THE WHO RECOMMENDATIONS, IN RELATION TO ANTHROPOMETRIC STATUS (24-H-RQ)

In the 2004 WHO Comparative Quantification of Health Risks, the theoretical-minimum-risk distribution (WHO recommendations) for fruit and vegetable intake (excluding potatoes) was estimated to be 330 grams per day in children aged 0 - 4 years and 480 grams in children aged 5 - 14 years.[33] The percentages of children consuming less than these WHO recommendations were compared, in relation to the children's HAZ, WAZ and WHZ, using the 24-H-RQ data.

3.5.1 Weight-for-age Z-scores

In the total sample of children, a significantly greater (Chi-square p=0.0295) percentage (95.5%) (n = 165) of underweight children (WAZ < -2 SD), consumed less than 330 grams fruit and vegetables per day, compared to children with a normal weight-for-age (≤ +2 SD WAZ ≥ -2 SD) and overweight children (WAZ > +2 SD).

3.5.2 Weight-for-height Z-scores

A significantly greater (Chi-square p=0.0317) proportion (96.8%) (n = 62) of wasted children (WHZ < -2 SD) consumed less than 330 grams of fruit and vegetables per day, in comparison to children with a normal weight-for-height (≤ +2 SD WHZ ≥ -2 SD) and overweight children (WHZ > +2 SD).

3.6 SOCIO-ECONOMICS

3.6.1 Head of household

3.6.1.1 Daily fruit and vegetable consumption (in grams) per capita per head of household category

The mean daily intake of fruit and vegetables by children in father-headed households (132.2 grams [SD 159.9]) (n = 906), measured by the 24-H-RQ, was significantly greater (Bonferroni $p<0.05$) than the intake by children in grandmother-headed households (92.6 grams [SD 131.6]) (n = 547) (Table 3.19; Figure 3.18). On analyses of the QFFQ data, there were no significant differences (Bonferroni $p>0.05$) in the mean fruit and vegetable intakes by children in father-, grandfather-, grandmother-, mother and other-headed households (Table 3.19; Figure 3.18).

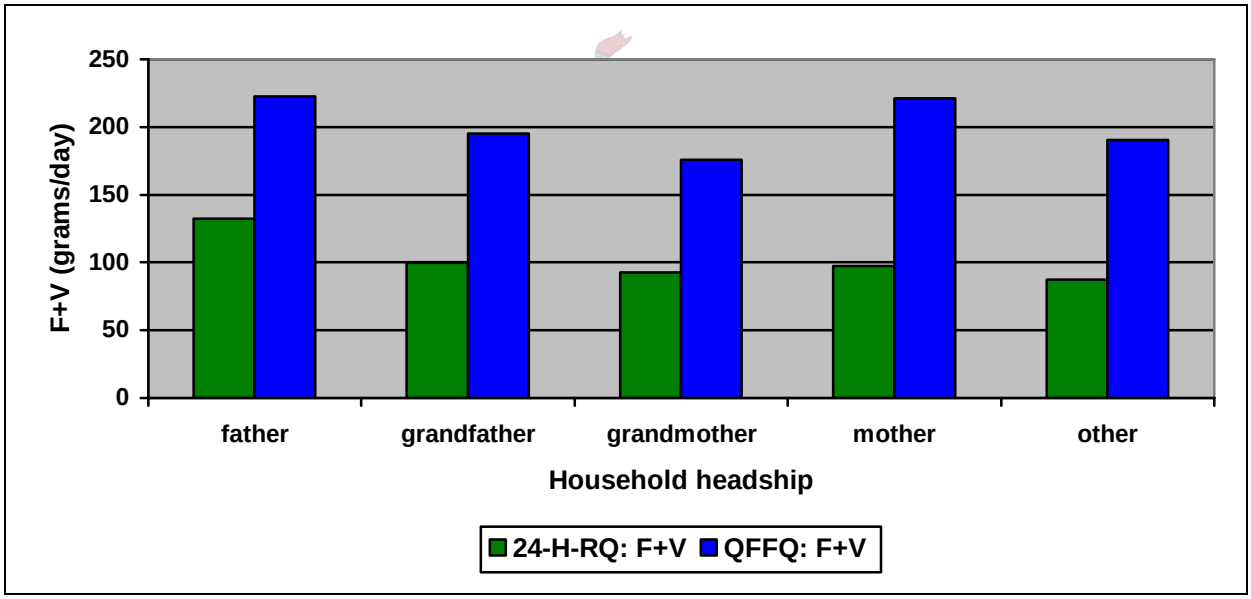

Figure 3.18: Mean daily intake per capita (in grams) of fruit and vegetables (F+V) in children per head of household category, as determined by the 24-H-RQ and QFFQ

3.6.1.2 Daily fruit consumption (in grams) per capita per head of household category

On comparison of the 24-H-RQ, no significant differences (Bonferroni $p>0.05$) were found in the mean daily fruit consumption by children in father-, grandfather-, and mother-headed households (Table 3.19; Figure 3.19). This was also true when comparing the children's mean fruit intakes, measured by the QFFQ, in father-, grandfather-, and mother-headed households. However, on analysis of the 24-H-RQ data, children in households with fathers as the head (71.3 grams [SD

135.5]) (n = 906), had a significantly greater (Bonferroni p<0.05) mean daily intake per capita of fruit than children in grandmother-headed households (36.8 grams [SD 95.5]) (n = 547). Similarly, a comparison of the QFFQ measurements showed that children in father-headed households (138.1 grams [SD 176.1]) (n = 868) consumed significantly more (Bonferroni p<0.05) fruit per day than children in grandmother-headed households (84.1 grams [SD 115]) (n = 533). (Table 3.19; Figure 3.19)

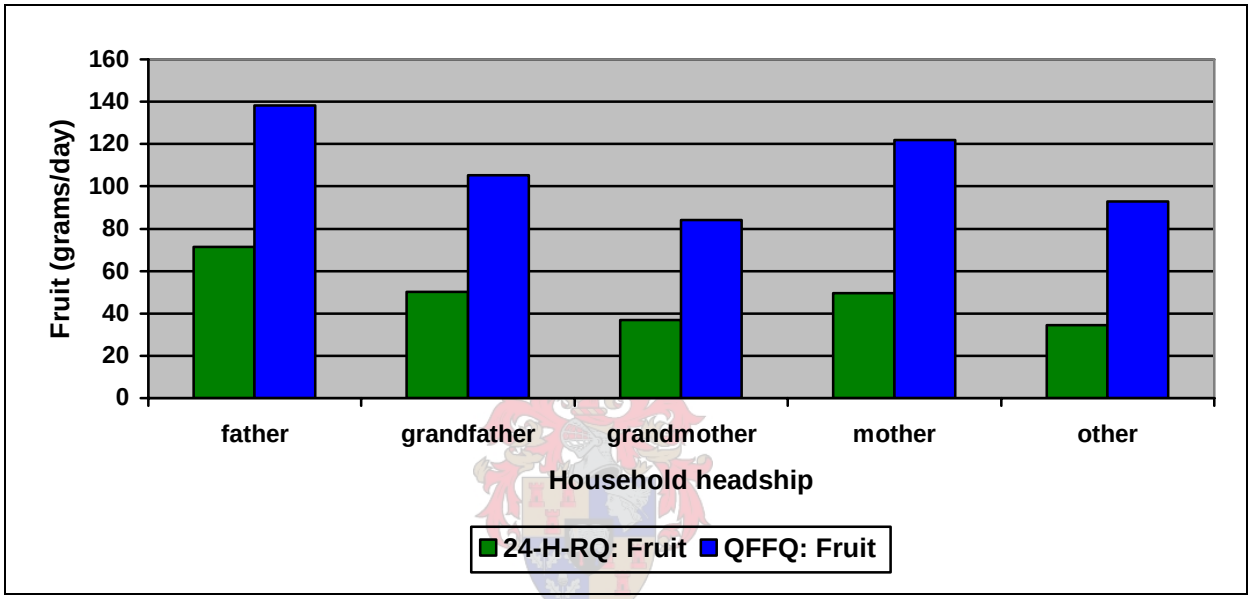

Figure 3.19: Mean daily intake per capita (in grams) of fruit in children per head of household category, as determined by the 24-H-RQ and QFFQ

3.6.1.3 Daily vegetable consumption (in grams) per capita per head of household category

The mean daily intakes of vegetables by children in father-, grandfather-, grandmother-, mother and other-headed households did not differ significantly (Bonferroni p>0.05). This was true when comparing the values from the 24-H-RQ and on comparison of the intakes measured by the QFFQ (Table 3.19).

Table 3.19: Mean daily intake per capita (in grams) of fruit and vegetables in children per head of household (HH) category, as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (g) 95% CI SD		Mean (g) 95% CI SD		Mean (g) 95% CI SD	
Head of HH	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
Father	906	868	132.2* 121.8 - 142.6 159.9	222.7 209.4 - 235.9 199.6	71.3* 62.4 - 80.1 135.5	138.1* 126.3 - 149.8 176.1	60.9 55.8 - 66 78.4	84.6 79.9 - 89.3 70.8
Gfath	371	360	99.6 82.9 - 116.3 163.6	195.4 177.9 - 212.9 169.3	50.1 35.9 - 64.3 139.4	105.2 91.4 - 119.1 133.4	49.5 43 - 56 63.9	90.1 81.2 - 99.1 86.2
Gmoth	547	533	92.6 81.6 - 103.7 131.6	175.7 162.9 - 188.4 150.5	36.8 28.8 - 44.8 95.5	84.1 74.3- 93.8 115	55.8 48.3 - 63.3 89.5	91.6 85.1 - 98.1 76.5
Mother	252	247	97.4 80.4 - 114.4 137.2	221.2 190.2 - 252.2 247.7	49.6 36.2 - 63.1 108.4	122 95.4 - 148.6 212.6	47.8 36.9 - 58.6 87.7	99.2 88.5 - 109.9 85.5
Other	88	88	87.2 62 - 112.4 119.2	190.3 160.1 - 220.4 142.5	34.5 15 - 54 92.1	93 70 - 116 108.7	53.7 36.6 - 68.7 76	97.2 79 - 115.5 86.3

HH: household; Gfath: Grandfather; Gmoth: Grandmother
* significantly greater (Bonferroni p<0.05) than grandmother-headed HH

3.6.1.4 Percentage of children consuming fruit and vegetables ('eaters') per head of household category

A comparison of the mean percentages of fruit and vegetables 'eaters', measured by the 24-H-RQ, revealed no significant difference (Bonferroni p>0.05) between father and grandfather-headed households (Table 3.20; Figure 3.20). However, a significantly higher percentage (Bonferroni p<0.05) of children consumed fruit and vegetables in father-headed households (62.9 % [SD 42.6]) (n = 906) than in grandmother-headed (51.2 % [SD 45]) (n = 547) and mother-headed households (49.3 % [SD 45.9]) (n = 252) (Table 3.20; Figure 3.20). On analyses of the QFFQ data, there were no significant differences (Bonferroni p>0.05) between the percentages of fruit and vegetable 'eaters' in grandfather-, grandmother- and father-headed households (Table 3.20; Figure 3.20). The mean percentage of fruit and vegetable 'eaters' in grandfather-headed households (98.5 % [SD 10.4]) (n = 360) was found to be significantly higher (Bonferroni p<0.05) than in mother-headed households (94.5 % [SD 21]) (n = 247) (Table 3.20; Figure 3.20).

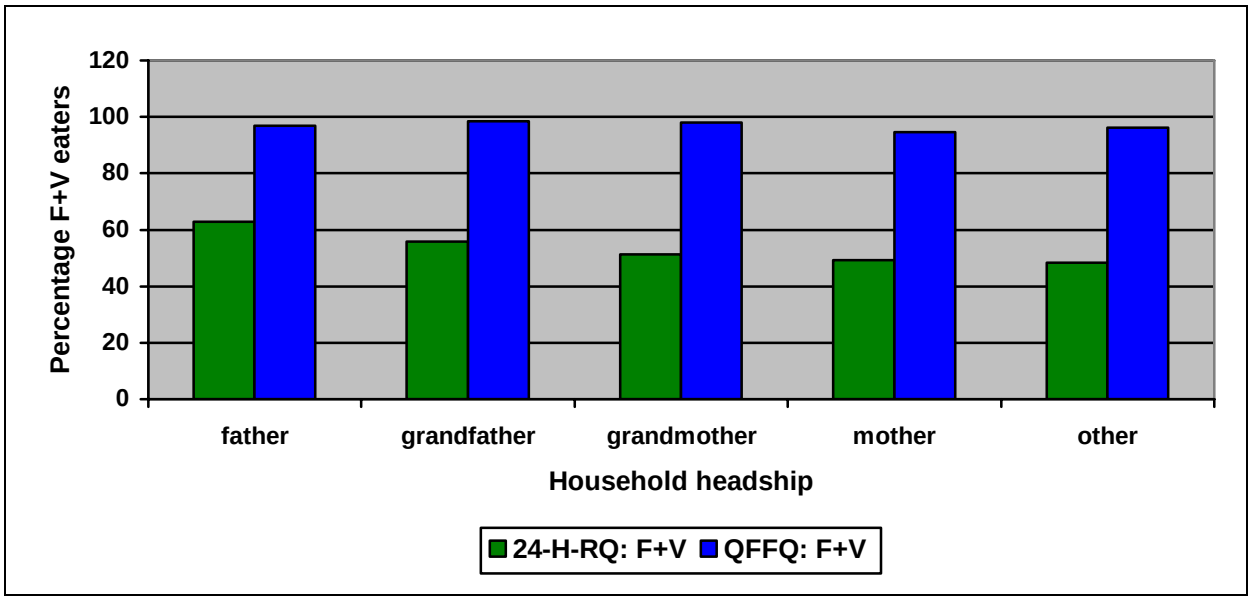

Figure 3.20: Mean percentages of children consuming fruit and vegetables (F+V eaters) per head of household category, as determined by the 24-H-RQ and QFFQ

3.6.1.5 Percentage of children consuming fruit ('eaters') per head of household category

On analysis of the 24-H-RQ data, the mean percentages of children eating fruit in father-, mother- and grandfather-headed homes did not differ significantly (Bonferroni $p>0.05$), but a significantly greater (Bonferroni $p<0.05$) percentage of children in father-headed households (28.1 % [SD 39.6]) (n = 868) ate fruit than in grandmother-headed households (16 % [SD 33]) (n = 533) (Table 3.20; Figure 3.21). As per the QFFQ measurements, grandfather-headed households (85.9 % [SD 29.9]) (n = 360) had a significantly higher (Bonferroni $p<0.05$) percentage of fruit 'eaters' than mother-headed households (75.3 % [SD 39.7]) (n = 247) (Table 3.20; Figure 3.21).

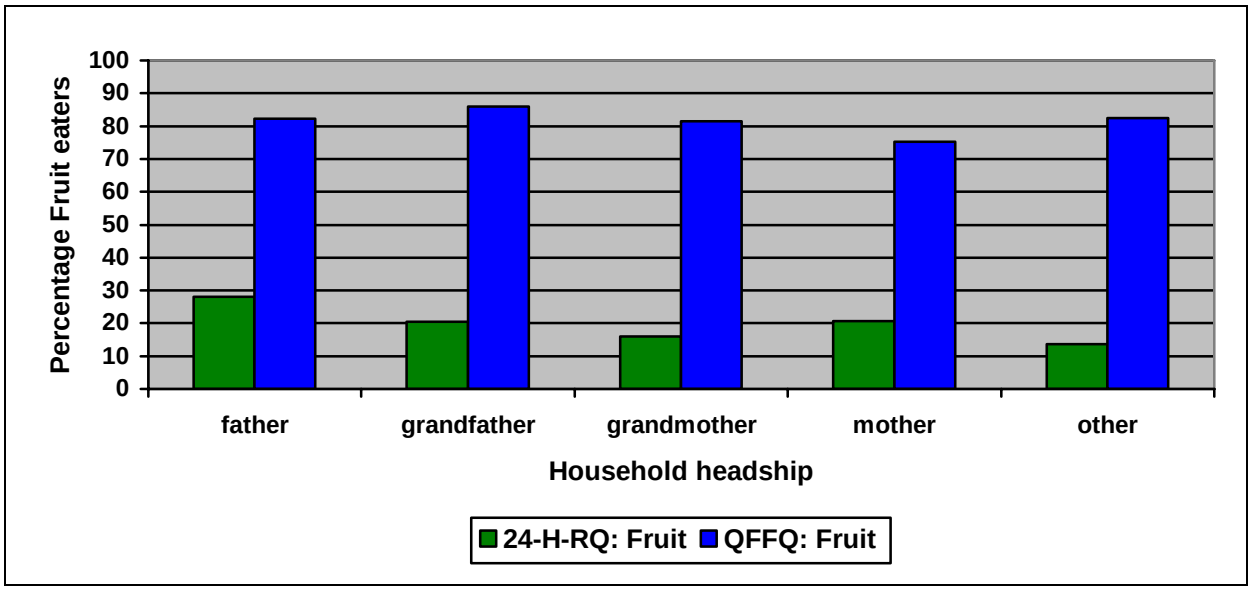

Figure 3.21: Mean percentages of children consuming fruit (Fruit eaters) per head of household category, as determined by the 24-H-RQ and QFFQ

3.6.1.6 Percentage of children consuming vegetable ('eaters') per head of household category

The mean percentages of vegetable 'eaters' in father-, grandfather-, grandmother-, mother and other-headed households did not differ significantly (Bonferroni $p>0.05$). This was true when comparing the values from the 24-H-RQ and on comparison of the intakes measured by the QFFQ (Table 3.20).

Table 3.20: Mean percentages (%) of children consuming fruit and vegetables per head of household (HH) category, as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (%) 95% CI SD		Mean (%) 95% CI SD		Mean (%) 95% CI SD	
Head of HH	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
Father	906	868	62.9** 60.1 - 65.7 42.6	96.8 95.8 - 97.9 15.4	28.1* 25.5 - 30.7 39.6	82.2 79.9 - 84.4 33.8	49.7 46.9 - 52.6 44.1	95.4 94.2 - 96.7 18.4
Gfath	371	360	55.7 51.3 - 60 42.7	98.5# 97.4 - 99.6 10.4	20.5 16.9 - 24 34.7	85.9# 82.8 - 89 29.9	45 40.7 - 49.4 42.7	97 95.5 - 98.5 14.6
Gmoth	547	533	51.2 47.5 - 55 45	98 96.9 - 99.1 12.6	16 13.2 - 18.8 33	81.5 78.5 - 84.5 35	42.8 39.1 - 46.5 44.5	96.4 95 - 97.8 16.7
Mother	252	247	49.3 43.6 - 55 45.9	94.5 91.9 - 97.1 21	20.6 16 - 25.3 37.2	75.3 70.4 - 80.3 39.7	38.8 33.2 - 44.3 44.8	93.2 90.3 - 96.1 23.2
Other	88	88	48.4 39.3 - 57.6 43.2	96.1 92.6 - 99.7 16.7	13.7 7.4 - 20 29.8	82.4 75.4 - 89.4 33	39.3 30.4 - 48.3 42.3	94.3 90 - 98.5 20.1

HH: household; Gfather: Grandfather; Gmoth: Grandmother
* significantly greater (Bonferroni p<0.05) than grandmother-headed HH
** significantly greater (Bonferroni p<0.05) than grandmother-headed and mother-headed HH
# significantly greater (Bonferroni p<0.05) than mother-headed HH

3.6.1.7 Frequency of consumption of fruit and vegetables per day per head of household category

The mean daily frequency of fruit and vegetable consumption was significantly higher in mother-headed (2.33 times per day [SD 1.87]) (n = 234) and father-headed households (2.32 times per day [SD 1.58]) (n = 840) in comparison to grandmother-headed households (1.91 times per day [SD 1.39]) (n = 523) (Table 3.21).

3.6.1.8 Frequency of consumption of fruit per day per head of household category

Similarly, the mean daily frequency of fruit intake in father-headed (0.96 times per day [SD 1.05]) (n = 868) and mother-headed households (0.85 times per day [SD 1.25]) (n = 247) was significantly greater (Bonferroni p<0.05) than in grandmother-headed households (0.60 times per day [SD 0.70]) (n = 533) (Table 3.21).

3.6.1.9 Frequency of consumption of vegetables per day per head of household category

The mean daily frequency of intake of vegetables by children in father-, grandfather-, grandmother-, mother and other-headed households did not differ significantly (Bonferroni p>0.05) (Table 3.21).

Table 3.21: Mean daily frequency of intake of fruit and vegetables in children per head of household (HH) category, as determined by the QFFQ

	Fruit and vegetables		Fruit		Vegetables	
Head of HH	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**
Father	2.32* 2.21 - 2.42 1.58	840	0.96* 0.89 - 1.03 1.05	868	1.34 1.28 - 1.41 0.93	828
Gfath	2.05 1.91 - 2.19 1.35	355	0.77 0.68 - 0.85 0.83	360	1.29 1.21 - 1.38 0.83	349
Gmoth	1.91 1.79 - 2.03 1.39	523	0.60* 0.54 - 0.66 0.70	533	1.32 1.24 - 1.40 0.96	514
Mother	2.33* 2.09 - 2.57 1.87	234	0.85* 0.70 - 1.01 1.25	247	1.45 1.32 - 1.58 0.99	230
Other	2.09 1.81 - 2.37 1.30	84	0.70 0.54 - 0.86 0.74	88	1.39 1.18 - 1.60 0.95	83

HH: household; Gfather: Grandfather; Gmoth: Grandmother
* significantly greater (Bonferroni p<0.05) than grandmother-headed HH

3.6.2 Household income

3.6.2.1 Daily fruit and vegetable consumption (in grams) per capita per household income category

On analysis of the 24-H-RQ, a significantly greater (Bonferroni p<0.05) mean intake per capita per day of fruit and vegetables was found amongst children in households within the uppermost monthly income category (> R1000), at 160.8 grams [SD 183.6] (n = 601) (Table 3.22; Figure 3.22). Correspondingly, the QFFQ data found that children from households earning more than R1000 per month (267.7 grams [SD 209.9]) (n = 579) consumed significantly more fruit and vegetables per day than children from households with a monthly income less than R1000 (Table 3.22; Figure 3.22).

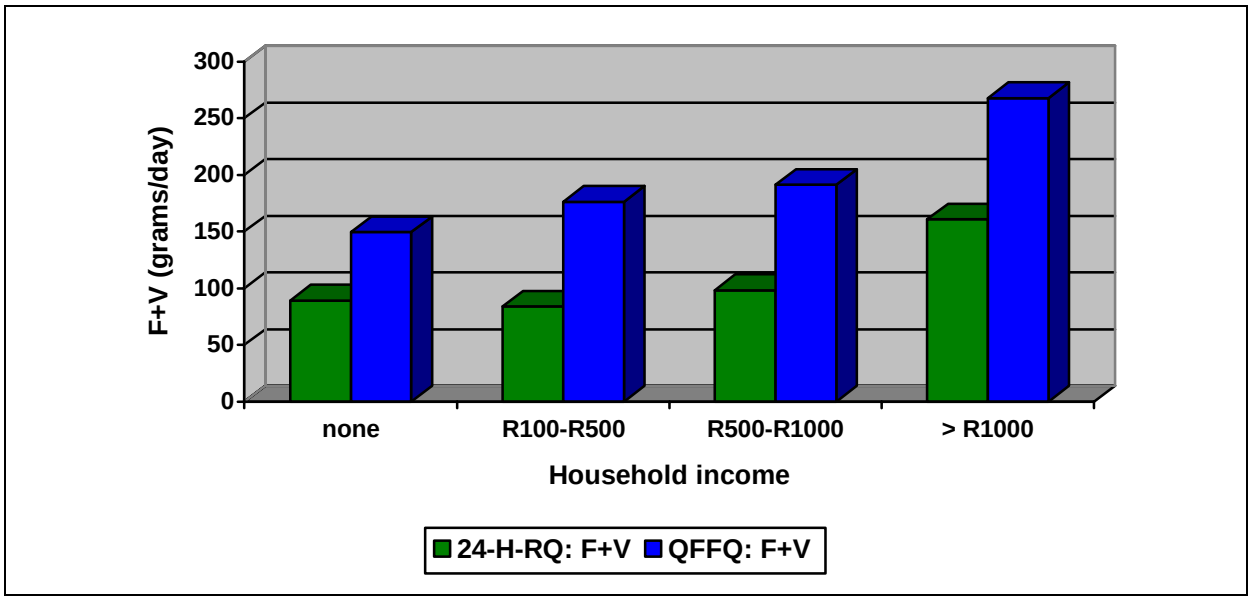

Figure 3.22: Mean daily intake per capita (in grams) of fruit and vegetables (F+V) in children per household income category, as determined by the 24-H-RQ and QFFQ

3.6.2.2 Daily fruit consumption (in grams) per capita per household income category

In households with a monthly income greater than R1000, children had a significantly higher (Bonferroni $p<0.05$) mean daily consumption per capita of fruit than children in the lower income categories (Table 3.22; Figure 3.23). This was found on comparison of the children's intakes measured by the 24-H-RQ (109 grams [SD 163.3]) (n = 579) and on comparison of the QFFQ intake data (181.6 grams [SD 180.8]) (n = 579) (Table 3.22; Figure 3.23). Additionally, the QFFQ analyses showed that the mean daily intake of fruit by children in households earning between R500 and R1000 (100.5 grams [SD 150]) (n = 511) was significantly greater (Bonferroni $p<0.05$) than in households with no formal income (57.8 grams [SD 122]) (n = 86) (Table 3.22; Figure 3.23).

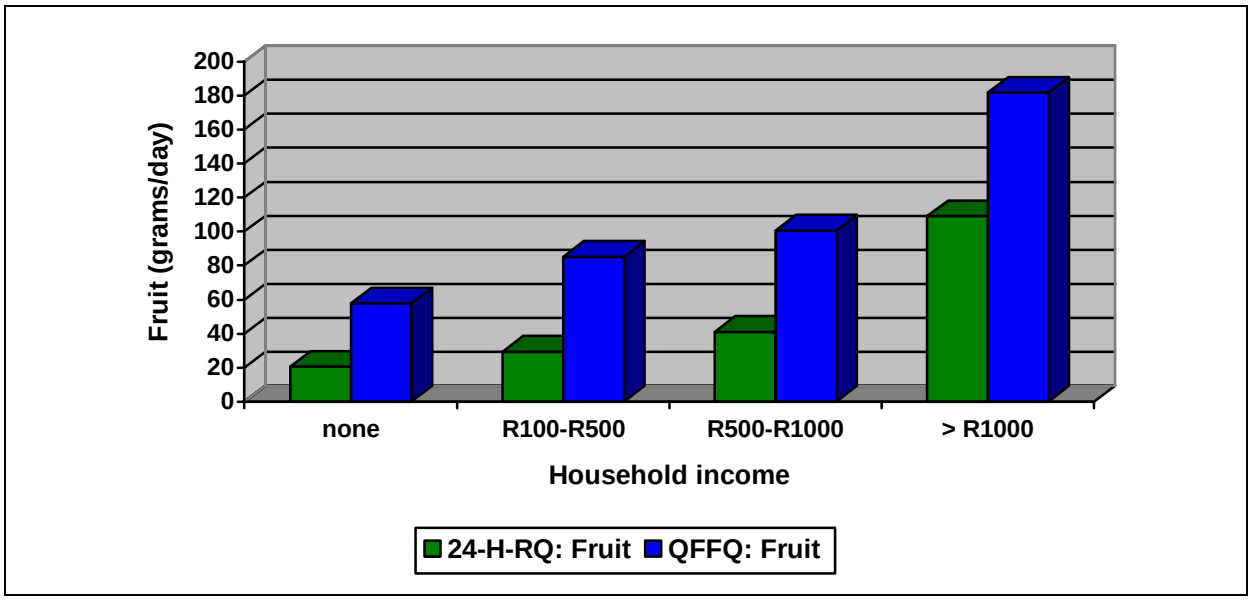

Figure 3.23: Mean daily intake per capita (in grams) of fruit in children per household income category, as determined by the 24-H-RQ and QFFQ

3.6.2.3 Daily vegetable consumption (in grams) per capita per household income category

The mean daily intake of vegetables by children did not differ significantly (Bonferroni $p>0.05$), according to the defined monthly household income categories, on comparison of the intakes measured by the 24-H-RQ in households from each of the income categories, and the same was found on comparison of the QFFQ intake data (Table 3.22; Figure 3.24).

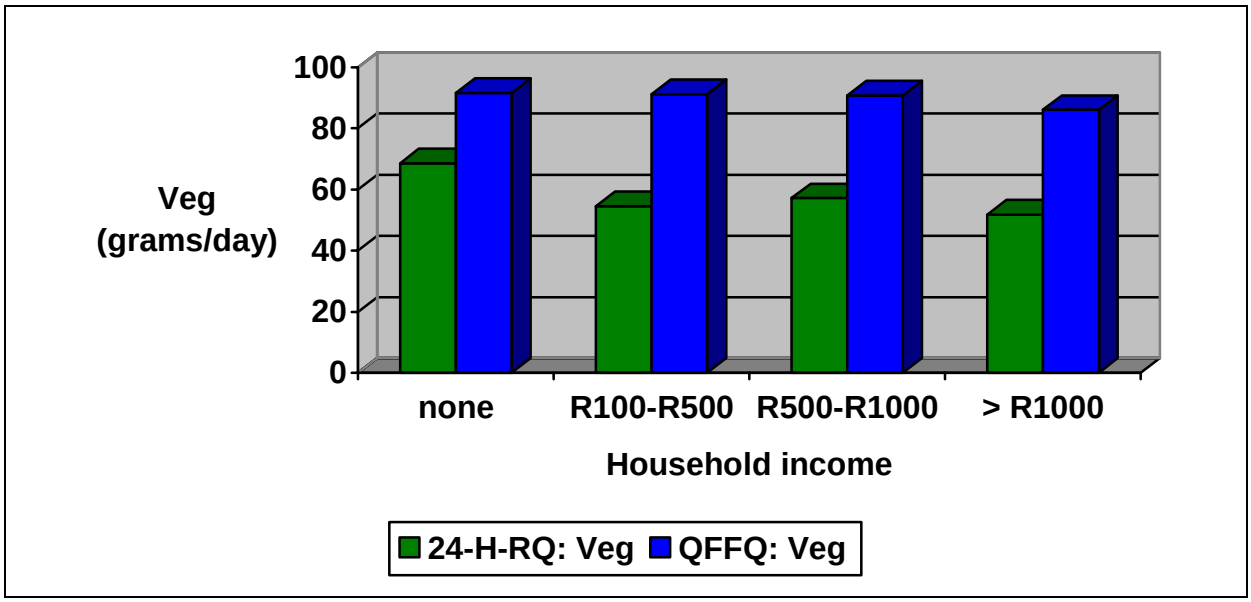

Figure 3.24: Mean daily intake per capita (in grams) of vegetables (Veg) in children per household income category, as determined by the 24-H-RQ and QFFQ

Table 3.22: Mean daily intake per capita (in grams) of fruit and vegetables in children per household (HH) income category, as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (g) 95% CI SD		Mean (g) 95% CI SD		Mean (g) 95% CI SD	
HH income	**N**	**N**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**	**24-H-RQ**	**QFFQ**
None	89	86	89.3 65.9 - 112.7 111.1	149.4 116.6 - 182.1 153.1	20.6 4.6 - 36.6 75.9	57.8 31.7 - 83.9 122	68.6 50.8 - 86.5 84.6	91.6 73.4 - 109.7 84.7
R100 – R500	696	681	84 73.2 - 94.2 145	176.2 162.4 - 190 183.4	29.5 21.4 - 37.6 109.2	85.1 73.6 - 96.5 152.7	54.5 48.4 - 60.6 82.4	91.2 85.4 - 96.9 76.3
R500 – 1000	531	511	98.2 87.6 - 108.7 123.6	191.2 175 - 206.6 178	41.1 33 - 49.1 94.7	100.5** 87.5 - 113.5 150	57.1 50 - 64.2 83.4	90.7 83.6 - 97.8 81.9
>R1000	601	579	160.8* 146.1 - 175.5 183.6	267.7* 250.5 - 284.8 209.9	109* 96 - 122.1 163.3	181.6* 166.9 - 196.4 180.8	51.8 46.4 - 57.2 67.3	86 80.3 - 91.7 69.8

HH: household
* significantly greater (Bonferroni p<0.05) than other income categories
** significantly greater (Bonferroni p<0.05) than HH with no income

3.6.2.4 Percentage of children consuming fruit and vegetables ('eaters') per household income category

Households with a monthly income greater than R1000 (67.8 % [SD 42.3]) (n = 601) had a significantly greater (Bonferroni $p<0.05$) mean percentage of children consuming fruit and vegetables than children in households with lower monthly earnings, when comparing the 24-H-RQ data (Table 3.23; Figure 3.25). On analysis of the QFFQ data, the mean percentages of children consuming fruit and vegetables did not differ significantly (Bonferroni $p>0.05$) amongst households with a monthly income greater than R1000, between R500 and R1000, between R100 and R500 and households with no income (Table 3.23; Figure 3.25).

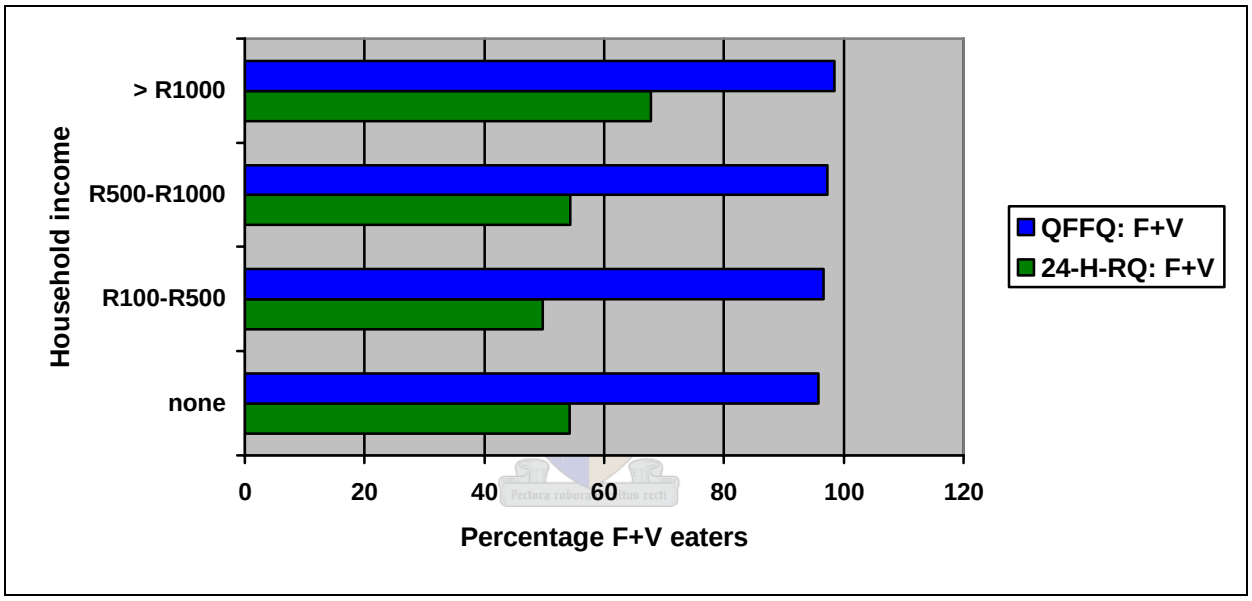

Figure 3.25: Mean percentages of children consuming fruit and vegetables (F+V) per household income category, as determined by the 24-H-RQ and QFFQ

3.6.2.5 Percentage of children consuming fruit ('eaters') per household income category

Comparisons using the 24-H-RQ data found that a significantly greater (Bonferroni $p<0.05$) percentage of children in the highest monthly household income category (> R1000) (42 % [SD 44.7%]) (n = 579) consumed fruit and a significantly greater (Bonferroni $p<0.05$) percentage of children from households with a monthly income of between R500 and R1000 consumed fruit, compared to children in households with no formal monthly income (Table 3.23; Figure 3.26). Similarly, on analysis of the QFFQ intakes, children in households earning more than R1000 per month (92.1 % [SD 24.5]) (n = 579) ate significantly more (Bonferroni $p<0.05$) fruit per day than children in households earning less or with no income and a significantly greater (Bonferroni $p<0.05$)

percentage of children from households with a monthly income of between R500 and R1000 consumed fruit, compared to children in households with no formal monthly income (Table 3.23; Figure 3.26).

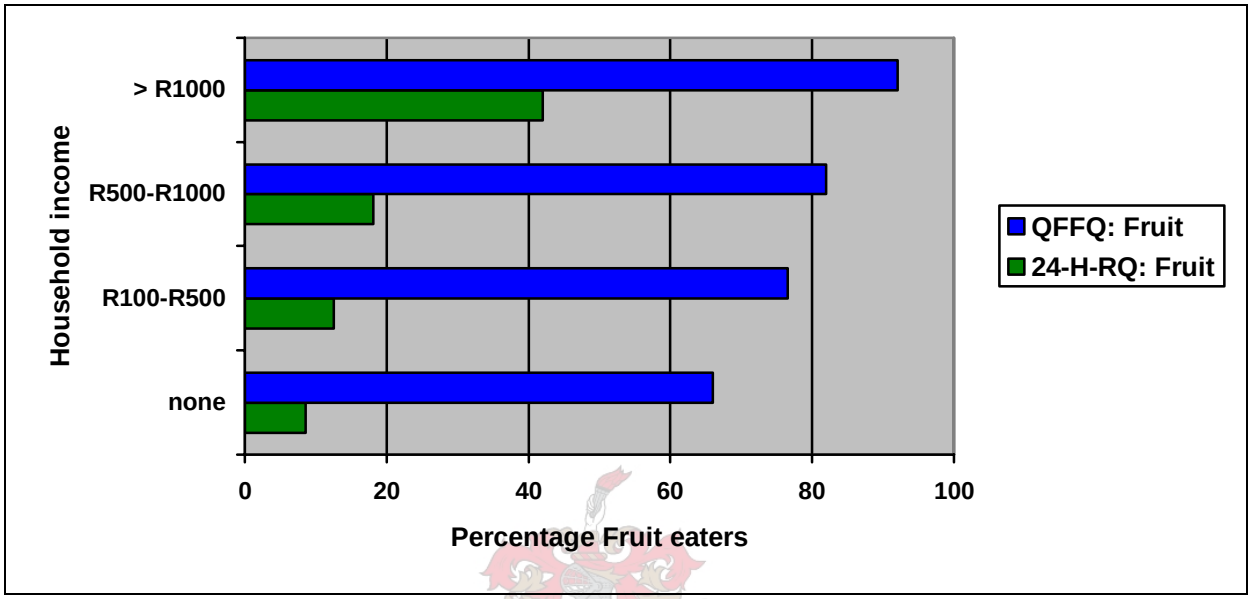

Figure 3.26: Mean percentages of children consuming fruit (Fruit eaters) per household income category, as determined by the 24-H-RQ and QFFQ

3.6.2.6 Percentage of children consuming vegetables ('eaters') per household income category

The mean percentages of vegetable 'eaters' in households with a monthly income greater than R1000, between R500 and R1000, between R100 and R500 and households with no income, did not differ significantly (Bonferroni $p>0.05$). This was true when comparing the percentages from the 24-H-RQ and on comparison of the percentages of vegetable 'eaters' measured by the QFFQ (Table 3.23).

Table 3.23: Mean percentages (%) of children consuming fruit and vegetables per household (HH) income category, as determined by the 24-H-RQ and QFFQ

			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (%) 95% CI SD		Mean (%) 95% CI SD		Mean (%) 95% CI SD	
HH income	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
None	89	86	54.2 44.8 - 63.6 44.5	95.8 92 - 99.7 18.1	8.6 3.4 - 14 25.1	66 56.8 - 75.1 42.8	48.9 39.5 - 58.3 44.6	94.2 89.7 - 98.7 21.1
R100 – R500	696	681	49.8 46.6 - 53.1 43.8	96.6 95.4 - 97.8 16	12.5 10.3 - 14.6 29	76.6 73.8 - 79.4 37.2	43 40.2 - 46.7 43.5	95.5 94.1 - 96.9 18.2
R500 – 1000	531	511	54.3 50.6 - 58 43.7	97.3 96 - 98.5 14.4	18.1** 15.2 - 21 33.8	82** 79.1 - 84.9 33.8	43.2 39.5 - 46.9 43.5	95.6 94 - 97.1 18.1
>R1000	601	579	67.8* 64.4 - 71.2 42.3	98.4 97.4 - 99.3 11.5	42* 38.5 - 45.6 44.7	92.1* 90.1 - 94.1 24.5	48.8 45.2 - 52.5 45.3	97.2 96 - 98.4 15

HH: household
* significantly greater (Bonferroni p<0.05) than other income categories
** significantly greater (Bonferroni p<0.05) than HH with no income

3.6.2.7 Frequency of consumption of fruit and vegetables per household income category

The mean daily frequency of fruit and vegetable consumption was significantly greater (Bonferroni p<0.05) in children in households with a monthly income greater than R1000 (2.84 times per day [SD 1.78]) (n = 570), in comparison to children in households earning less per month (Table 3.24). Additionally, the mean daily frequency of fruit and vegetable consumption by children in households earning between R500 and R1000 per month (2.03 times per day [SD 1.38]) (n = 497) was significantly greater (Bonferroni p<0.05) than in households with no monthly income (1.60 times per day [SD 1.19]) (n = 82) (Table 3.24).

3.6.2.8 Frequency of consumption of fruit per household income category

Children in households with a monthly income greater than R1000 (1.29 times per day [SD 1.14]) (n = 579) had a significantly greater (Bonferrroni p<0.05) mean daily frequency of fruit intake than the children in households with a lower monthly income (Table 3.24). A significantly higher (Bonferroni p<0.05) frequency of fruit intake per day was also found amongst children from households earning between R500 and R1000 per month (0.73 times per day [SD 0.90]) (n = 511) in comparison to households with no formal income (0.40 times per day [SD 0.71]) (n = 86) (Table 3.24).

3.6.2.9 Frequency of consumption of vegetables per household income category

A significantly greater (Bonferrroni p<0.05) mean daily frequency of vegetable intake (1.55 times per day [SD 1.03]) (n = 563) was found in children from the uppermost household income category (>

R1000 per month), in comparison to the frequency of vegetable intake in children from households earning less than R1000 per month (Table 3.24)

Table 3.24: Mean daily frequency of intake of fruit and vegetables in children per household (HH) income category, as determined by the QFFQ

	Fruit and vegetables		Fruit		Vegetables	
HH income	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**	**Mean daily intake freq 95% CI SD**	**N**
None	1.60 1.34 - 1.86 1.19	82	0.40 0.25 - 0.55 0.71	86	1.20 1.00 - 1.40 0.89	81
R100 – R500	1.78 1.68 - 1.88 1.28	657	0.56 0.50 - 0.62 0.78	681	1.21 1.51 - 1.28 0.82	650
R500 – 1000	2.03** 1.91 - 2.15 1.38	497	0.73** 0.65 - 0.81 0.90	511	1.30 1.22 - 1.38 0.87	489
>R1000	2.84* 2.70 - 2.99 1.78	570	1.29* 1.19 - 1.38 1.14	579	1.55* 1.47 - 1.64 1.03	563

HH: household
* significantly greater (Bonferroni p<0.05) than other income categories
** significantly greater (Bonferroni p<0.05) than HH with no income

3.6.3 Education level of mother

3.6.3.1 Daily fruit and vegetable consumption (in grams) per capita per education level of mother category

Children of mothers with a tertiary education (219.4 grams [SD 222]) (n = 177) consumed a significantly greater (Bonferroni p<0.05) quantity of fruit and vegetables per day than children whose mothers were less educated, according to the 24-H-RQ data analyses (Table 3.25; Figure 3.27). Similarly, comparison using the QFFQ measurements found a significantly greater (Bonferroni p<0.05) mean intake per capita of fruit and vegetables amongst children of mothers with a tertiary education (319.3 grams [SD 227.5]) (n = 171) compared to the intakes by children whose mothers were less educated (Table 3.25; Figure 3.27).

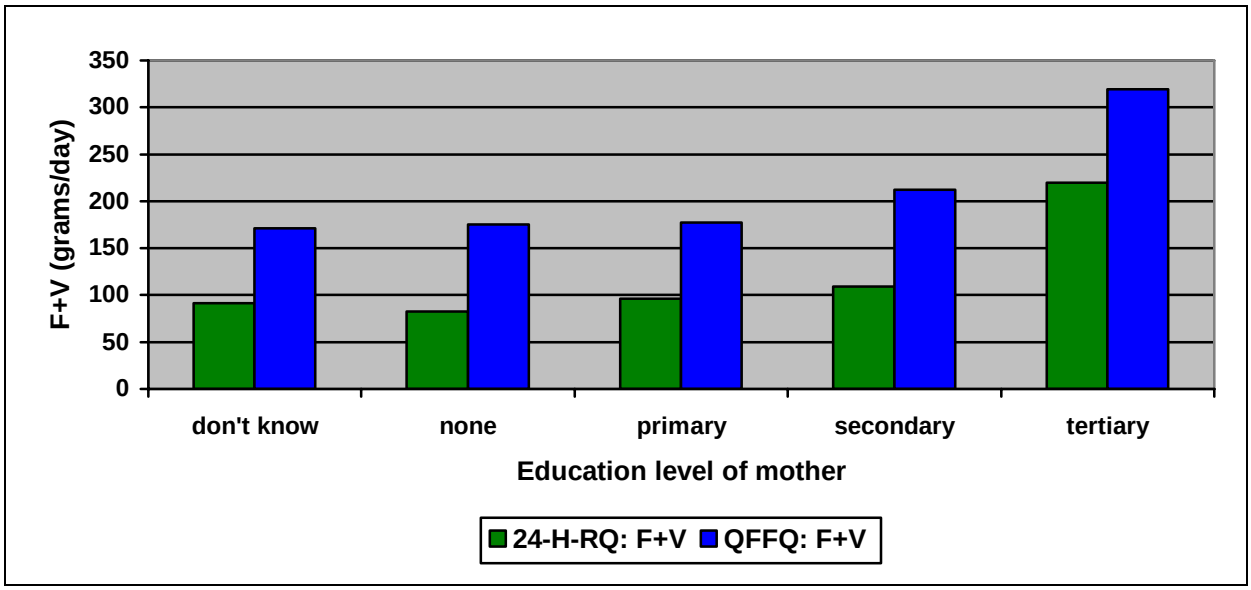

Figure 3.27: Mean daily intake per capita (in grams) of fruit and vegetables (F+V) in children per education level of mother category, as determined by the 24-H-RQ and QFFQ

3.6.3.2 Daily fruit consumption (in grams) per capita per education level of mother category

Comparisons using the 24-H-RQ measurements found that the mean consumption of fruit per day was significantly higher (Bonferroni $p<0.05$) amongst children whose mothers had a tertiary qualification (156.7 grams [SD 196.9]) (n = 177) (Table 3.25; Figure 3.28). Similarly, analyses of the QFFQ intake data found that the children of mothers with a tertiary education (219.6 grams [SD 192.3]) (n = 171) ate significantly more fruit than the other children (Table 3.25; Figure 3.28). Additionally, the 24-H-RQ analyses found that the mean quantity of fruit consumed by the children of mothers with a secondary education (57.2 grams [SD 115.7]) (n = 1123) was significantly greater (Bonferroni $p<0.05$) than the intakes of children whose mothers did not know their level of education (22.6 grams [SD 64.8]) (n = 89) or who had no formal education (17.5 grams [SD 55.7]) (n = 198) (Table 3.25; Figure 3.28).

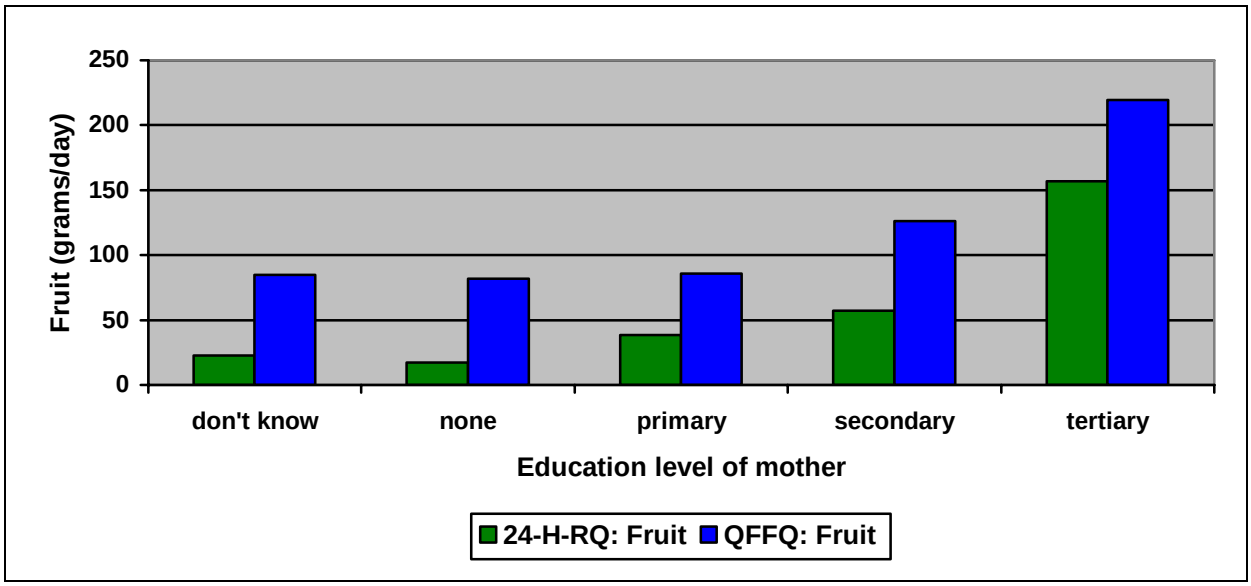

Figure 3.28: Mean daily intake per capita (in grams) of fruit in children per education level of mother category, as determined by the 24-H-RQ and QFFQ

3.6.3.3 Daily vegetable consumption (in grams) per capita per education level of mother category

Mean daily intakes of vegetables by children did not differ significantly (Bonferroni $p>0.05$) amongst children with mothers from the defined education categories, on analysis of both the 24-H-RQ and the QFFQ results (Table 3.25).

Table 3.25: Mean daily intake per capita (in grams) of fruit and vegetables in children per education level of mother (Educ level mother) category, as determined by the 24-H-RQ and QFFQ

Educ level mother			Fruit and vegetables		Fruit		Vegetables	
	24-H-RQ	QFFQ	Mean (g) 95% CI SD		Mean (g) 95% CI SD		Mean (g) 95% CI SD	
	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
Don't know	89	88	91.3 65.9 - 116.7 121.1	171.4 138.4 - 204.4 156.2	22.6* 9 - 36.1 64.8	84.7 60.7 - 108.7 113.5	68.8 47 - 90.5 103.8	86.7 69.1 - 104.4 83.5
None	198	192	82.7 67.8 - 97.6 106.7	175.2 143.1 - 207.4 226.2	17.5* 9.7 - 25.3 55.7	82 53.9 - 110.1 197.9	65.2 53 - 77.4 87.3	93.2 82.4 - 104.1 76.5
Prim	500	490	96.3 82.4 - 110.2 158.4	177.4 161.1 - 193.6 183.1	38.5 27.3 - 49.6 126.9	85.6 72.4 - 98.8 149.1	57.8 50.8 - 64.9 80.6	91.8 84.4 - 99.1 82.9
Sec	1123	1081	108.9 100.7 - 117 139.5	212.1 201.5 - 222.8 178.3	57.2** 50.4 - 64 115.7	126 116.9 - 135.1 152.9	51.7 47.2 - 56.1 76.5	86.1 81.9 - 90.9 70.4
Tert	177	171	219.4* 186.5 - 252.3 222	319.2* 284.9 - 353.5 227.5	156.7* 127.5 - 185.9 196.9	219.6* 190.6 - 248.5 192.3	62.7 51 – 74.4 79	99.6 86.4 - 112.9 88.2

Educ: Education; Prim: Primary; Sec: Secondary; Tert: Tertiary
* significantly greater (Bonferroni p<0.05) than other education categories
** significantly greater (Bonferroni p<0.05) than HH with mothers with no education or who don't know their education

3.6.3.4 Percentage of children consuming fruit and vegetables ('eaters') per education level of mother category

According to the 24-H-RQ measurements, a significantly greater (Bonferroni p<0.05) mean percentage of children whose mothers had a tertiary education, consumed fruit and vegetables (75.2 % [SD 40]) (n = 177) (Table 3.26; Figure 3.29). However, mean percentages of children eating fruit and vegetables, as measured by the QFFQ, did not differ significantly (Bonferroni p>0.05) according to the education level of their mothers (Table 3.26; Figure 3.29).

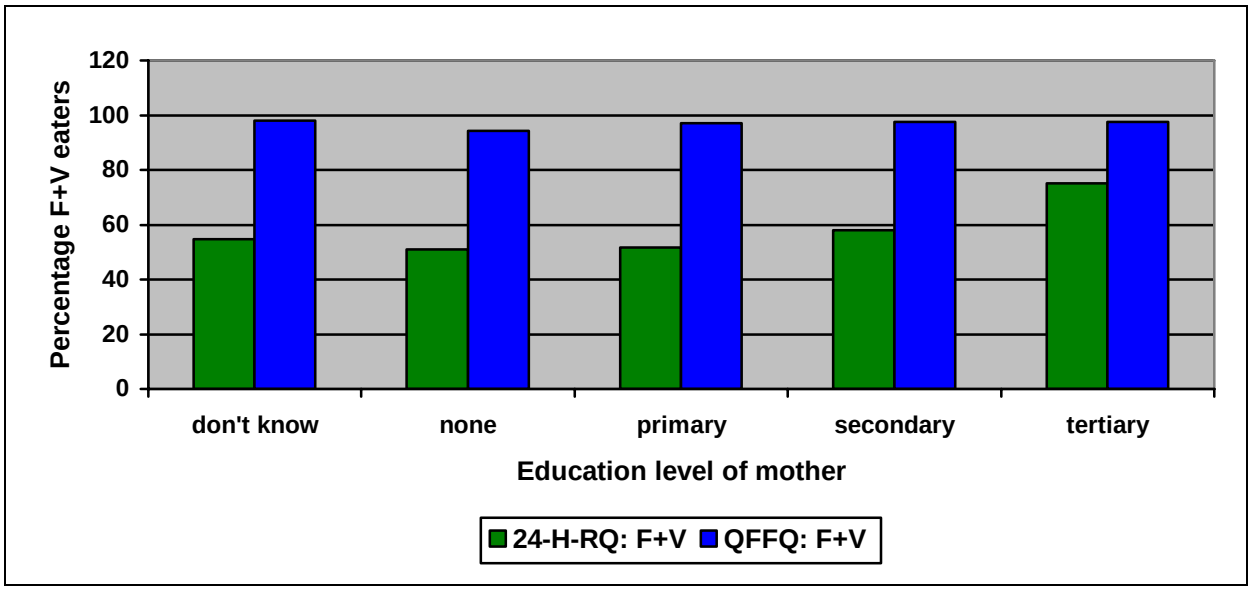

Figure 3.29: Mean percentages of children consuming fruit and vegetables (F+V eaters) per education level of mother category, as determined by the 24-H-RQ and QFFQ

3.6.3.5 Percentage of children consuming fruit ('eaters') per education level of mother category

A significantly greater (Bonferroni $p<0.05$) percentage of fruit 'eaters', was found amongst children whose mothers had a tertiary education (52.9 % [SD 46.3]) (n = 177), on analysis of the 24-H-RQ data (Table 3.26; Figure 3.30). The percentage fruit 'eaters' amongst children from mothers with a secondary education (24.7 % [SD 38.4]) (n = 1123) was significantly higher (Bonferroni $p<0.05$) than the percentage of fruit 'eaters' whose mothers did not know their level of education (11.8 % [SD 27.9]) or whose mothers had no formal education (9.5 % [SD 25.4]) (Table 3.26; Figure 3.30). Comparisons of the QFFQ measurements revealed a significantly greater (Bonferroni $p<0.05$) mean percentage of fruit 'eaters' amongst children whose mothers had a tertiary (93.5 % [SD 22.9]) (n = 171) or secondary (86.3 % [SD 30.6]) (n = 1081) education than children whose mothers had lesser educations (Table 3.26; Figure 3.30).

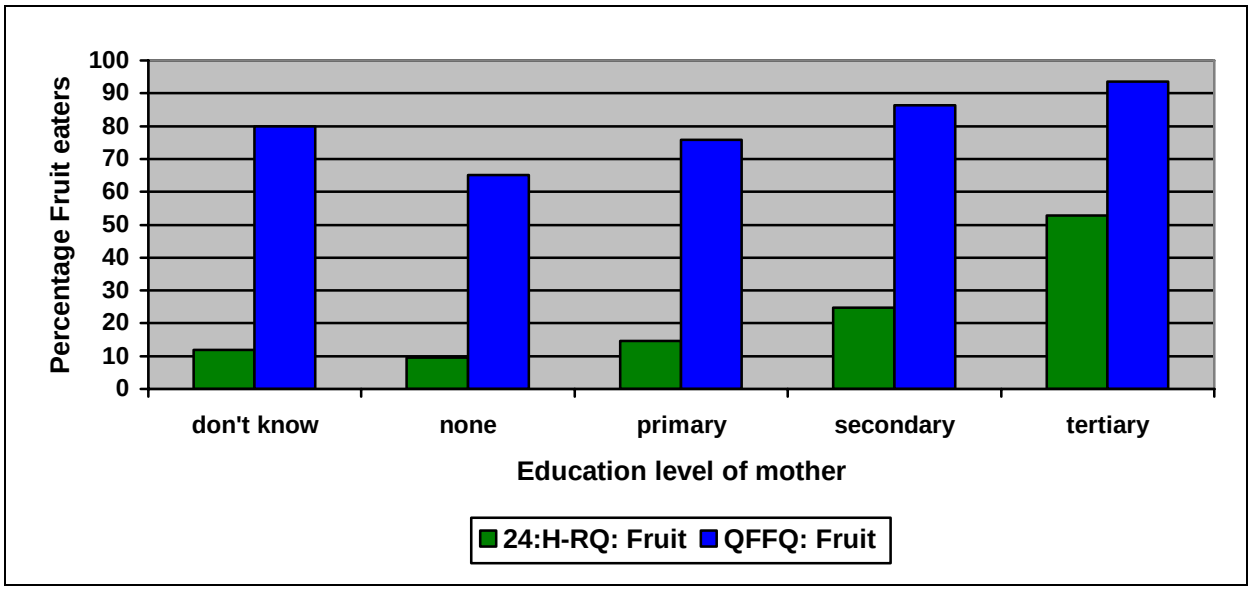

Figure 3.30: Mean percentages of children consuming fruit (Fruit eaters) per education level of mother category, as determined by the 24-H-RQ and QFFQ

3.6.3.6 Percentage of children consuming vegetables ('eaters') per education level of mother category

According to the 24-H-RQ measurements, the greatest percentage of vegetable 'eaters' was found amongst children whose mothers had a tertiary education (56.1 % [SD 46]) (n = 177) and this proportion was significantly greater (Bonferroni $p<0.05$) than the lowest percentage of vegetable 'eaters', which was found amongst children whose mothers had a primary school education (43.6 % [SD 42.6]) (n = 500) (Table 3.26; Figure 3.31). Mean percentages of vegetable 'eaters' did not differ significantly (Bonferroni $p>0.05$) amongst children with mothers who had different education levels, on comparison of the QFFQ measurements. (Table 3.26; Figure 3.31)

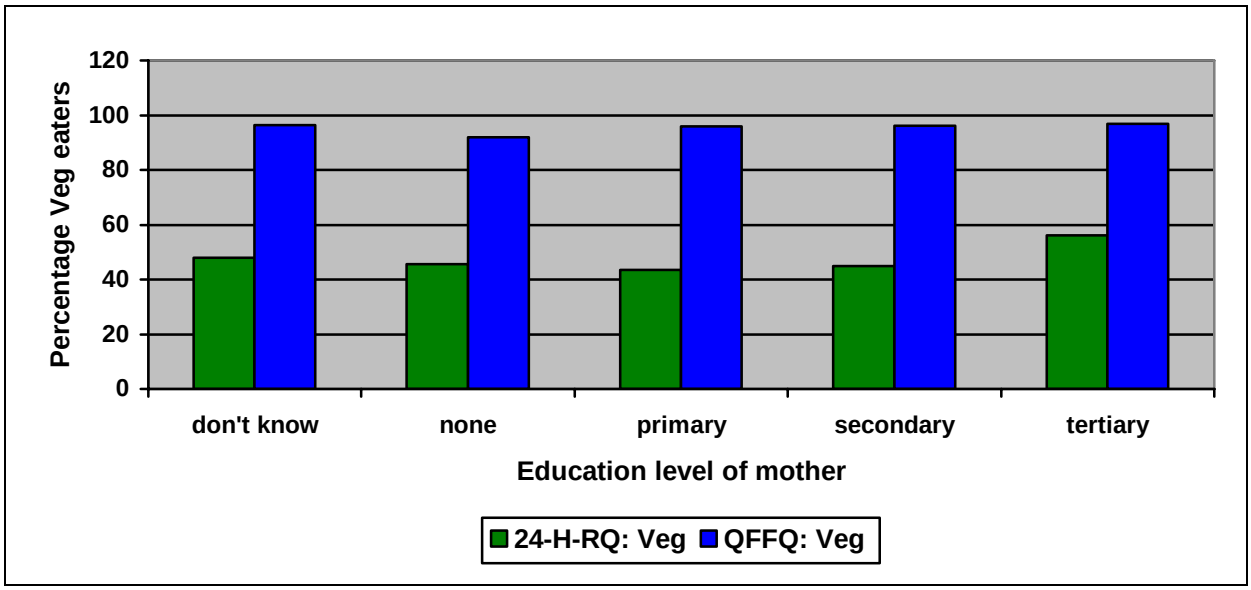

Figure 3.31: Mean percentages of children consuming vegetables (Veg eaters) per education level of mother category, as determined by the 24-H-RQ and QFFQ

Table 3.26: Mean percentages (%) of children consuming fruit and vegetables per education level of mother (Educ level mother) category, as determined by the 24-H-RQ and QFFQ

Educ level mother	24-H-RQ	QFFQ	Fruit and vegetables		Fruit		Vegetables	
			Mean (%) 95% CI SD		Mean (%) 95% CI SD		Mean (%) 95% CI SD	
	N	N	24-H-RQ	QFFQ	24-H-RQ	QFFQ	24-H-RQ	QFFQ
Don't know	89	88	54.7 45.7 - 63.7 43.1	98.1 95.6 - 100 11.8	11.8 5.9 - 17.6 27.9	80 72.6 - 87.3 34.8	47.9 38.8 - 57 43.2	96.3 92.8 - 99.8 16.4
None	198	192	51 44.9 - 57.1 43.4	94.3 91.4 - 97.1 20.2	9.5 5.9 - 13 25.4	65.1 59.2 - 71 41.4	45.7 39.3 - 51.4 43.3	92 88.6 - 95.3 23.6
Prim	500	490	51.7 47.9 - 55.4 43.2	97.1 95.8 - 98.4 14.7	14.7 12 - 17.4 30.6	75.8 72.5 - 79.1 37.2	43.6 39.9 - 47.4 42.8	96 94.5 - 97.5 17.1
Sec	1123	1081	58 55.4 - 60.6 44	97.6 96.8 - 98.5 13.5	24.7** 22.4 - 26.9 38.4	86.3* 84.5 - 88.2 30.6	44.9 42.3 - 47.5 44.3	96.2 95.2 - 97.2 17
Tert	177	171	75.2* 69.3 - 81.2 40	97.5 95.4 - 99.7 14.4	52.9* 46.1 - 59.8 46.3	93.5* 90 - 96.9 22.9	56.1# 49.3 - 63 46	96.9 94.5 - 99.3 16.1

Educ: Education; Prim: Primary; Sec: Secondary; Tert: Tertiary
* significantly greater (Bonferroni p<0.05) than other education categories
** significantly greater (Bonferroni p<0.05) than HH with mothers with no education or who don't know their education
# significantly greater (Bonferroni p<0.05) than HH with mothers with primary education

3.6.3.7 Frequency of consumption of fruit and vegetables per education level of mother category

The mean daily frequency of fruit and vegetable consumption was significantly greater (Bonferroni $p<0.05$) amongst children whose mothers had a tertiary education (3.47 times per day [SD 2.05]) (n = 167), in comparison to the children whose mothers had lesser levels of education (Table 3.27). Children whose mothers had a secondary education (2.26 times per day [SD 1.47]) (n = 1055) had a significantly greater (Bonferroni $p<0.05$) mean daily frequency of fruit and vegetable consumption in comparison to children of mothers with a primary school education (1.77 times per day [SD 1.30]) (n = 475) (Table 3.27).

3.6.3.8 Frequency of consumption of fruit per education level of mother category

Children whose mothers had tertiary (1.58 times per day [SD 1.34]) (n = 171) or secondary (0.90 times per day [SD 0.93]) (n = 1081) education levels, had a significantly greater (Bonferroni $p<0.05$) mean daily frequency of fruit consumption in comparison to the children whose mothers had lesser levels of education (Table 3.27).

3.6.3.9 Frequency of consumption of vegetables per education level of mother category

A significantly greater (Bonferrroni $p<0.05$) mean daily frequency of vegetable intake was found in children whose mothers had a tertiary education (1.86 times per day [SD 1.19]) (n = 166), in comparison to the children of mothers with lower levels of education (Table 3.27).

Table 3.27: Mean daily frequency of intake of fruit and vegetables in children per education level of mother (Educ level mother) category, as determined by the QFFQ

Educ level mother	Fruit and vegetables		Fruit		Vegetables	
	Mean daily intake freq 95% CI SD	N	Mean daily intake freq 95% CI SD	N	Mean daily intake freq 95% CI SD	N
Don't know	1.89 1.55 - 2.22 1.56	86	0.63 0.46 - 0.80 0.80	88	1.27 1.06 - 1.49 1.01	85
None	1.84 1.63 - 2.06 1.46	181	0.53 0.38 - 0.67 1.00	192	1.32 1.18 - 1.45 0.91	176
Prim	1.77 1.65 - 1.89 1.30	475	0.57 0.50 - 0.65 0.80	490	1.19 1.12 - 1.27 0.84	470
Sec	2.26# 2.17 - 2.35 1.47	1055	0.90 0.85 - 0.96 0.93	1081	1.36 1.30 - 1.41 0.90	1040
Tert	3.47* 3.16 - 3.78 2.05	167	1.58* 1.38 - 1.78 1.34	171	1.86* 1.68 - 2.04 1.19	166

Educ: Education; Prim: Primary; Sec: Secondary; Tert: Tertiary
* significantly greater (Bonferroni p<0.05) than other education categories
# significantly greater (Bonferroni p<0.05) than HH with mothers with primary education

3.7 FRUIT AND VEGETABLE CONSUMPTION AND THE WHO RECOMMENDATIONS, IN RELATION TO SOCIO-ECONOMICS (24-H-RQ)

The percentages of children consuming less than the WHO theoretical-minimum-risk distribution of 330 grams per day for children aged 0 - 4 years[33] were compared, in relation to the defined socio-economic indicators, using the 24-H-RQ data.

3.7.1 Household income

In the total sample of children aged 12 - 108 months, the percentage (88.9%) (n = 534) of children consuming less than 330 grams per day of fruit and vegetables, was significantly lower (Chi-square p<0.0001) in households earning more than R1000 per month.

3.7.2 Education level of mother

A significantly lower (Chi-square p<0.0001) percentage (80.4%) (n = 142) of children, consumed less than 330 grams per day of fruit and vegetables, when their mothers had a tertiary qualification.

3.8 PROCUREMENT OF FRUIT AND VEGETABLES

3.8.1 Relevant results from the NFCS

At the national level, the FPHIQ used in the NFCS found that the six food items most frequently procured and the ones that were found most frequently in the house were maize, sugar, tea, whole milk, brown bread and hard margarine. A general trend observed at the national level, was that most households procured these items by purchasing them. The data from the 24-H-RQ and QFFQ indicated that these same six items were also the most commonly consumed food items. Subsistence agriculture was not, therefore, a major source of these foods in the country. According to the description of foods available in the households and the foods in the NFCS household inventory, children in low income homes were found to have a repetitive diet, dependent on cereals and with a poor variety, as animal foods, legumes, fruit and vegetables were not frequently available. Household food insecurity was found in the NFCS, to be high in the lower income households due to the low number of food items found and consumed by children in these households, as determined by the food inventory and the 24HR, respectively.[34]

Additionally, it was found that the great majority of the foods most commonly eaten by children (as measured by the 24-H-RQ and the QFFQ) are procured by purchase. All four methodologies employed collectively in the NFCS, supported the role of income as being decisive in the consumption and procurement of foods.[34]

3.8.2 Fruit and vegetable procurement

3.8.2.1 National and provincial fruit and vegetable procurement

Nationally, the vast majority of households (90.2 %) procured fruit and vegetables by purchase, with 6.6% of fruit and vegetables being cultivated by households for their consumption (Table 3.28). The same trend was seen in all provinces in terms of source of procurement of fruit and vegetables. The greatest percentage of households purchasing fruit and vegetables was found in the North West (97.8 %), and the smallest percentage in Limpopo (79.2 %), where cultivation by households was at 14.9 % (Table 3.28).

In terms of frequency of purchase, a similar percentage of households nationally purchased fruit and vegetables weekly (41.3 %) and fortnightly (40.7 %) (Table 3.29) The provincial pattern, in terms of frequency of purchase of fruit and vegetables varied greatly. In the North West (52.9 %), the Western Cape (52.2 %) and Gauteng (52.7 %), more than half of households purchased fruit and vegetables weekly (Table 3.29). The majority of households purchased fruit and vegetables fortnightly in the

Free State (49.7 %), Mpumalanga (51.6 %), the Eastern Cape (40.3 %), Kwazulu-Natal (49.8 %), Mpumalanga (51.6) and Limpopo (56 %) (Table 3.29). In the Northern Cape, a similar percentage of households purchased fruit and vegetables weekly (36.1 %) and fortnightly (28.2 %), with one in five households (20.2 %) purchasing fruit and vegetables daily or twice a week (Table 3.29).

Table 3.28: Percentage (%) of households nationally and provincially, procuring fruit and/or vegetables through purchasing, growing or other sources, as determined by the FPHIQ

	Sources of procurement of fruit and/or vegetables		
Region	**Purchased (%)**	**Grown (%)**	**Other (%)**
RSA	90.2	6.6	3.2
Eastern Cape	81.7	12.8	5.5
Free State	80.7	12.5	6.8
Gauteng	97.5	1.1	1.4
Kwazulu-Natal	82.8	13.6	3.6
Mpumalanga	94	4.2	1.8
Northern Cape	96.2	0.9	2.9
Limpopo	79.2	14.9	5.9
North West	97.8	1.2	1
Western Cape	96.3	0.9	2.8

Table 3.29: Frequency of purchase of fruit and/or vegetables, nationally and provincially, expressed as a percentage of households purchasing, as determined by the FPHIQ

	Frequency of purchase of fruit and vegetables by households				
Region	**Daily/2xweek (%)**	**Weekly (%)**	**Fortnightly (%)**	**Monthly (%)**	**Special occasions (%)**
RSA	7.6	41.3	40.7	1.7	8.7
Eastern Cape	13.4	29.3	40.3	1.4	15.6
Free State	10.2	30.6	49.7	4.3	5.3
Gauteng	9.1	52.7	34.1	1	3.2
Kwazulu-Natal	2	29.9	49.8	3.5	14.8
Mpumalanga	8.9	22.7	51.6	0.9	16
Northern Cape	20.2	36.1	28.2	6.6	9
Limpopo	5.3	17.3	56	5.9	15.4
North West	14.7	52.9	29	1	2.4
Western Cape	3.7	52.2	39.1	0	4.9

3.8.2.2 Fruit and vegetable procurement and head of household

The vast majority of households procured fruit and vegetables by purchase, irrespective of head of household. Slightly greater absolute percentages of fruit and vegetables were grown in households where the grandfather (8.2 %) or grandmother (8.8 %) was the head (Table 3.30)

In terms of frequency of purchase, a similar percentage of households purchased fruit and vegetables daily/2 x week, weekly, fortnightly, monthly and on special occasions, in all the head of household categories (Table 3.31).

Table 3.30: Percentage (%) of households by head of household, procuring fruit and/or vegetables through purchasing, growing or other sources, as determined by the FPHIQ

Household headship	Sources of procurement of fruit and/or vegetables		
	Purchased (%)	Grown (%)	Other (%)
Father	91.6	5.3	3.1
Grandfather	88.5	8.2	3.3
Grandmother	87.6	8.8	3.6
Mother	91.5	6.1	2.4
Other	91.9	4.9	3.2

Table 3.31: Frequency of purchase of fruit and/or vegetables, by head of household, expressed as a percentage of households purchasing, as determined by the FPHIQ

Head of household	Frequency of purchase of fruit and vegetables by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
Father	6.2	39.7	44.1	1.2	8.8
Grandfather	8.5	42.9	39.4	2.3	6.9
Grandmother	8.8	43.6	36.7	1.9	8.9
Mother	7.8	42.1	39	2.2	8.9
Other	11.6	38	35.3	1.2	14

3.8.2.3 Fruit and vegetable procurement and household income

In all the household income categories, the vast majority of households procured fruit and vegetables by purchase (Table 3.32). The greatest percentage of households purchasing fruit and vegetables was found in the uppermost household income category (95.5 %) and only 2.6 % of these households cultivated their own fruit and vegetables (Table 3.32). The percentage of households cultivating their own fruit and vegetables increased as household income decreased (Table 3.32). Thirteen percent (13 %) of households with no income were cultivating their own fruit and vegetables and 79.8 % of these households purchased their fruit and vegetables (Table 3.32).

In terms of frequency of purchase, a similar percentage of households purchased fruit and vegetables daily/2 x week, weekly, fortnightly and monthly in all the household income categories (Table 3.33). A slightly greater percentage of households with no income purchased fruit and vegetables daily/2 x week (10.9 %) compared to households in the uppermost income category (4.5 %). (Table 3.33) A greater proportion of households with no income purchased fruit and vegetables on special occasions (23.6 %) (Table 3.33)

Table 3.32: Percentage (%) of households by household income, procuring fruit and/or vegetables through purchasing, growing or other sources, as determined by the FPHIQ

Household income	Sources of procurement of fruit and/or vegetables		
	Purchased (%)	Grown (%)	Other (%)
None	79.8	13	7.2
R100-R500	84.9	10.7	4.4
R500-R1000	89.5	7.1	3.4
> R1000	95.5	2.6	1.9

Table 3.33: Frequency of purchase of fruit and/or vegetables, by household income, expressed as a percentage of households purchasing, as determined by the FPHIQ

Household income	Frequency of purchase of fruit and vegetables by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
None	10.9	31.1	29.1	5.3	23.6
R100-R500	9.5	38.9	37.3	2.9	11.3
R500-R1000	9.3	41.9	39	1.5	8.3
> R1000	4.5	42.5	45.9	0.9	6.2

3.8.2.4 Fruit and vegetable procurement and education level of the mother

The vast majority of households procured fruit and vegetables by purchase, in all the education level of the mother categories (Table 3.34) In households where mothers had a tertiary education, a greater percentage of households (95.2 %) purchased fruit and vegetables, in comparison to growing their own (2.9 %) (Table 3.34). As the education level of the mother decreased the percentage of households cultivating their own fruit and vegetables increased. In households where the mother had no formal education, 14.5 % of households cultivated their own fruit and vegetables and 79.9 %

A similar percentage of households purchased fruit and vegetables weekly and fortnightly, in all the education level of the mother categories (Table 3.35). A slightly greater percentage of households where mothers had no formal education purchased fruit and vegetables daily/2 x week (9.7 %) compared to households where mothers had a tertiary education (3.6 %) (Table 3.35).

Table 3.34: Percentage (%) of households by education level of the mother, procuring fruit and/or vegetables through purchasing, growing or other sources, as determined by the FPHIQ

Education level of mother	Sources of procurement of fruit and/or vegetables		
	Purchased (%)	Grown (%)	Other (%)
Don't know	89.9	7	3.1
None	79.9	14.5	5.6
Primary	85.4	9.9	4.7
Secondary	92.6	4.8	2.6
Tertiary	95.2	2.9	1.9

Table 3.35: Frequency of purchase of fruit and/or vegetables, by education level of the mother, expressed as a percentage of households purchasing, as determined by the FPHIQ

Household income	Frequency of purchase of fruit and vegetables by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
Don't know	10.9	36.8	37.8	2.9	12.4
None	9.7	26.9	44.6	2.2	16
Primary	8.5	41	37.8	1.5	10.5
Secondary	7.7	45.2	38	1	7.6
Tertiary	3.6	36.5	51.3	8.6	7.4

3.8.3 Fruit procurement

3.8.3.1 National and provincial fruit procurement

The vast majority of households (97 %) in South Africa procured fruit by purchase, with only 1.5% of fruit being grown by households for their consumption. The greatest percentage of households growing their own fruit was found in Limpopo (7.4 %) (Table 3.36)

In terms of frequency of purchase, a similar percentage of households nationally purchased fruit weekly (42.9 %) and fortnightly (35.1 %) (Table 3.37). The provincial pattern, in terms of frequency of purchase of fruit varied greatly. In the Northern Cape, the majority of households purchased fruit daily/2 x week (27.5 %) and fortnightly (25.2 %). In the North West (52.5 %), the Western Cape (56.7 %) and Gauteng (50.6 %), more than half of households purchased fruit weekly (Table 3.37). The majority of households purchased fruit fortnightly in the Free State (60.1 %), Mpumalanga (37.8 %) and Limpopo (50.1 %) (Table 3.37). One in four households in Mpumalanga purchased fruit weekly (25.4 %) and daily/2 x week (10.2 %) and in Limpopo, about one in five households purchased fruit weekly (21.6 %) and on special occasions (20.4 %) (Table 3.37). In the Eastern Cape and Kwazulu-Natal, a similar percentage of households purchased fruit weekly (Eastern Cape: 34.1 %; Kwazulu-Natal: 33.7 %) and fortnightly (Eastern Cape: 38.2 %; Kwazulu-Natal: 39.2 %) (Table 3.37).

Table 3.36: Percentage (%) of households nationally and provincially, procuring fruit through purchasing, growing or other sources, as determined by the FPHIQ

	Sources of procurement of fruit		
Region	**Purchased (%)**	**Grown (%)**	**Other (%)**
RSA	97	1.5	1.5
Eastern Cape	99.2	0.1	0.7
Free State	92.8	4.4	2.8
Gauteng	98.8	0.7	0.5
Kwazulu-Natal	95.1	2.5	2.4
Mpumalanga	95.5	3.3	1.2
Northern Cape	96.9	1.2	1.9
Limpopo	88.4	7.4	4.2
North West	99.2	0.6	0.2
Western Cape	97.3	0.8	1.9

Table 3.37: Frequency of purchase of fruit, nationally and provincially, expressed as a percentage of households purchasing, as determined by the FPHIQ

	Frequency of purchase of fruit by households				
Region	**Daily/2xweek (%)**	**Weekly (%)**	**Fortnightly (%)**	**Monthly (%)**	**Special occasions (%)**
RSA	7.5	42.9	35.1	2.1	12.46
Eastern Cape	6	34.1	38.2	1.7	20
Free State	6.6	12.6	60.1	9.3	11.5
Gauteng	11.6	50.6	30.7	1.4	5.8
Kwazulu-Natal	2.7	33.7	39.2	4.4	20
Mpumalanga	10.2	25.4	37.8	0.6	26
Northern Cape	27.5	16.1	25.2	16	15.2
Limpopo	3.7	21.6	50.1	4.2	20.4
North West	15.9	52.5	27.6	0.8	3.1
Western Cape	4.8	56.7	31.6	0	6.9

3.8.3.2 Fruit procurement and head of household

Most households (> 95 %) procured fruit by purchase, irrespective of the head of the household (Table 3.38). In terms of frequency of purchase, a similar percentage of households purchased fruit daily/2 x week, weekly, fortnightly and monthly in all the head of household categories (Table 3.39).

Table 3.38: Percentage (%) of households by head of household, procuring fruit through purchasing, growing or other sources, as determined by the FPHIQ

Household headship	Sources of procurement of fruit		
	Purchased (%)	**Grown (%)**	**Other (%)**
Father	97.4	1.2	1.4
Grandfather	96.7	1.8	1.5
Grandmother	96.7	1.7	1.6
Mother	97.2	1.8	1
Other	96.9	1.4	1.7

Table 3.39: Frequency of purchase of fruit, by head of household, expressed as a percentage of households purchasing, as determined by the FPHIQ

Head of household	Frequency of purchase of fruit by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
Father	6.6	43.7	34.6	1.4	13.7
Grandfather	9.7	40.4	37.4	3.2	9.4
Grandmother	7.1	43.3	34.5	2.9	12.2
Mother	7.6	43.6	35.7	2.7	10.4
Other	9.8	39.1	32.9	0.6	17.6

3.8.3.3 Fruit procurement and household income

In all the household income categories, the greatest percentage of households procured fruit by purchase (Table 3.40).

In terms of frequency of purchase, a similar percentage of households purchased fruit weekly and fortnightly, in all the household income categories (Table 3.41). A greater percentage of households with no income purchased fruit on special occasions (34.3 %) compared to households in the other income categories (10.2 – 15.2 %) (Table 3.41). Most households (48 %) with a monthly income greater than R1000 purchased fruit on a weekly basis (Table 3.41).

Table 3.40: Percentage (%) of households by household income, procuring fruit through purchasing, growing or other sources, as determined by the FPHIQ

Household income	Sources of procurement of fruit		
	Purchased (%)	Grown (%)	Other (%)
None	95	2.3	2.7
R100-R500	96.4	1.7	1.9
R500-R1000	96.6	2.1	1.3
> R1000	97.7	1.1	1.2

Table 3.41: Frequency of purchase of fruit, by household income, expressed as a percentage of households purchasing, as determined by the FPHIQ

Household income	Frequency of purchase of fruit by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
None	8.5	27.7	23.9	5.6	34.3
R100-R500	6.2	37.3	36.6	4.7	15.2
R500-R1000	10.3	39.9	37.2	1.7	10.9
> R1000	6	48	35.2	0.7	10.2

3.8.3.4 Fruit procurement and education level of the mother

The vast majority of households procured fruit by purchase, in all the education level of the mother categories (Table 3.42). A similar percentage of households purchased fruit daily/2 x week, weekly,

monthly and fortnightly, in all the education level of the mother categories (Table 3.43). A slightly greater percentage of households where mothers had no formal education purchased fruit on special occasions (22.2 %) compared to households where mothers had a primary (15.1 %), secondary (10.3 %) or tertiary (12.8 %) education (Table 3.43).

Table 3.42: Percentage (%) of households by education level of the mother, procuring fruit through purchasing, growing or other sources, as determined by the FPHIQ

Education level of mother	Sources of procurement of fruit		
	Purchased (%)	Grown (%)	Other (%)
Don't know	98.1	0.8	1.1
None	97.3	0.8	1.9
Primary	96.1	1.7	2.2
Secondary	97.4	1.5	1.1
Tertiary	97.3	1.6	1.1

Table 3.43: Frequency of purchase of fruit, by education level of the mother, expressed as a percentage of households purchasing, as determined by the FPHIQ

Household income	Frequency of purchase of fruit by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
Don't know	12.5	35.3	32	4.3	15.9
None	8.5	25	39.5	4.9	22.2
Primary	7.6	36.4	38.4	2.5	15.1
Secondary	8.1	48.1	31.6	1.8	10.3
Tertiary	3.9	43.8	38.5	1	12.8

3.8.4 Vegetable procurement

3.8.4.1 National and provincial vegetable procurement

The majority of households (88.3 %) in South Africa procured vegetables by purchase, with only 8.2 % of vegetables being cultivated by households for their consumption (Table 3.44). The greatest percentage of households growing their own vegetables was found in the Eastern Cape (17.9 %), followed by Kwazulu-Natal (17.3 %) and Limpopo (14.1 %), with the Northern Cape (0.2 %), the Western Cape (0.8 %) and Gauteng (0.9 %) having the lowest percentages of households practicing subsistence vegetable farming (Table 3.44).

In terms of frequency of purchase, a similar percentage of households nationally purchased vegetables weekly (40.3 %) and fortnightly (44 %) (Table 3.45). The provincial pattern, in terms of frequency of purchase of vegetables varied greatly (Table 3.45). The greatest percentage of households purchased vegetables on a weekly basis in the North West (53.1 %), the Northern Cape (48.4 %) and Gauteng (52.6 %) (Table 3.45). The majority of households purchased vegetables

fortnightly in Mpumalanga (60.6 %), Limpopo (58.2 %), Kwazulu-Natal (55.6 %) and the Eastern Cape (41.1 %). In the Free State (weekly: 38.2%; fortnightly: 44.3 %) and the Western Cape (weekly: 49.4%; fortnightly: 43.8 %), a similar percentage of households purchased vegetables weekly and fortnightly (Table 3.45).

Table 3.44: Percentage (%) of households nationally and provincially, procuring vegetables through purchasing, growing or other sources, as determined by the FPHIQ

	Sources of procurement of vegetables		
Region	**Purchased (%)**	**Grown (%)**	**Other (%)**
RSA	88.3	8.2	3.5
Eastern Cape	74.6	17.9	7.5
Free State	88.8	8.3	2.9
Gauteng	98.2	0.9	0.9
Kwazulu-Natal	78.8	17.3	3.9
Mpumalanga	93.4	4.4	2.2
Northern Cape	96.5	0.2	3.3
Limpopo	80.3	14.1	5.6
North West	97.4	1.3	1.3
Western Cape	96.1	0.8	3.1

Table 3.45: Frequency of purchase of vegetables, nationally and provincially, expressed as a percentage of households purchasing, as determined by the FPHIQ

	Frequency of purchase of vegetables by households				
Region	**Daily/2xweek (%)**	**Weekly (%)**	**Fortnightly (%)**	**Monthly (%)**	**Special occasions (%)**
RSA	7.7	40.3	44	1.4	6.5
Eastern Cape	18.1	26.7	41.1	1.2	12.9
Free State	12.3	38.2	44.3	2.3	2.9
Gauteng	7.7	52.6	37.1	0.8	1.8
Kwazulu-Natal	1.6	27.8	55.6	3.1	11.8
Mpumalanga	8.2	20.4	60.6	1.1	9.8
Northern Cape	17.7	48.4	30.7	1.4	1.8
Limpopo	6.4	15.8	58.2	7.2	12
North West	14	53.1	29.9	0.8	2
Western Cape	3	49.4	43.8	0.1	3.7

3.8.4.2 Vegetable procurement and head of household

Most households (> 85 %) procured vegetables by purchase, irrespective of the head of the household (Table 3.46). Slightly greater percentages of vegetables were cultivated in households where the grandfather (10.6 %) or grandmother (11 %) was the head (Table 3.46).

In terms of frequency of purchase, a similar percentage of households purchased vegetables daily/2 x week, weekly, fortnightly and monthly in all the head of household categories (Table 3.47).

Table 3.46: Percentage (%) of households by head of household, procuring vegetables through purchasing, growing or other sources, as determined by the FPHIQ

Household headship	Sources of procurement of vegetables		
	Purchased (%)	Grown (%)	Other (%)
Father	90.3	6.3	3.4
Grandfather	85.5	10.6	3.9
Grandmother	85.3	11	3.7
Mother	90	7.2	2.8
Other	90.5	5.3	4.2

Table 3.47: Frequency of purchase of vegetables, by head of household, expressed as a percentage of households purchasing, as determined by the FPHIQ

Head of household	Frequency of purchase of vegetables by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
Father	6.1	37.3	49.6	1.1	5.8
Grandfather	8	43.2	41.1	1.9	5.8
Grandmother	9.8	43.9	37.8	1.5	6.9
Mother	8.1	41.4	41.1	1.8	7.6
Other	12.7	38	36.1	1.6	11.6

3.8.4.3 Vegetable procurement and household income

In all the household income categories, the greatest percentage of households procured vegetables by purchase (Table 3.48). The greatest percentage of households purchasing vegetables was found in the uppermost household income category (94.7 %) and only 3.3 % of these households cultivated their own vegetables (Table 3.48). The percentage of households growing their own vegetables increased as household income decreased (Table 3.48). In households with no income, 16.2 % were cultivating their own vegetables and 78.1 % purchased their vegetables (Table 3.48).

In terms of frequency of purchase, a similar percentage of households purchased vegetables weekly and fortnightly, in all the household income categories (Table 3.49). A greater percentage of households with no income purchased vegetables on special occasions (18.2 %) compared to households in the other income categories (4 – 8.9 %) (Table 3.49).

Table 3.48: Percentage (%) of households by household income, procuring vegetables through purchasing, growing or other sources, as determined by the FPHIQ

Household income	Sources of procurement of vegetables		
	Purchased (%)	Grown (%)	Other (%)
None	78.1	16.2	5.7
R100-R500	82.4	12.8	4.8
R500-R1000	87.5	8.7	3.8
> R1000	94.7	3.3	2

Table 3.49: Frequency of purchase of vegetables, by household income, expressed as a percentage of households purchasing, as determined by the FPHIQ

Household income	Frequency of purchase of vegetables by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
None	12.8	34.5	29.8	4.8	18.2
R100-R500	11.6	40.1	37.5	1.9	8.9
R500-R1000	8.8	43.2	40	1.3	6.6
> R1000	3.6	39.3	52.1	1	4

3.8.4.4 Vegetables procurement and education level of the mother

Most of the households in all the education level of the mother categories procured vegetables by purchase (Table 3.50). In households where mothers had a tertiary education, the greatest percentage of households (94.6 %) purchased vegetables, and 3.4 % of these households cultivated their own vegetables (Table 3.50). As the education level of the mother decreased, the percentage of households cultivating their own vegetables increased. In households where the mother had no formal education, 18.3 % of households grew their own vegetables and 76.2 % purchased their vegetables (Table 3.50).

A similar percentage of households purchased vegetables daily/2 x week, weekly, fortnightly and monthly in all the education level of the mother categories (Table 3.51). A slightly greater percentage of households where mothers had no formal education purchased fruit and vegetables daily/2 x week (10.9 %) compared to households where mothers had a tertiary education (3.3 %) (Table 3.51).

Table 3.50: Percentage (%) of households by education level of the mother, procuring vegetables through purchasing, growing or other sources, as determined by the FPHIQ

Education level of mother	Sources of procurement of vegetables		
	Purchased (%)	Grown (%)	Other (%)
Don't know	87.1	9.8	3.1
None	76.2	18.3	5.5
Primary	82.6	12.3	5.1
Secondary	91.1	5.8	3.1
Tertiary	94.6	3.4	2

Table 3.51: Frequency of purchase of vegetables, by education level of the mother, expressed as a percentage of households purchasing, as determined by the FPHIQ

Household income	Frequency of purchase of vegetables by households				
	Daily/2xweek (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Special occasions (%)
Don't know	10.1	37.7	40.9	0.9	10.5
None	10.9	27.1	47.1	1.9	13.1
Primary	9.4	44.1	37.3	1.9	7.3
Secondary	7.6	43.4	41.7	1.3	6
Tertiary	3.3	32	59.2	1.1	4.3

CHAPTER 4: DISCUSSION

4.1 INTRODUCTION

This study describes for the first time fruit and vegetable consumption at the national level in South African children. The study has documented that the consumption and frequency of intake of fruit and vegetables is poor, with intakes that are well below WHO guidelines, both nationally, provincially and across the age range of 12 – 108 months. Wasted (< -2 SD WHZ) and underweight (< -2 SD WAZ) children had significantly lower fruit and vegetable intake and lower total energy intakes. A consistent positive association was found between household income and fruit and vegetable intakes and children of more formally educated mothers also had better intakes of fruit and vegetables. Consistent trends were observed in the results of this study; however, there were some disparities in the measurements associated with the different dietary methodologies employed. The findings of this study provide health policy-makers and educators with data on which nutrition interventions could be based.

4.1.1 Dietary methodology

There are well-known fundamental differences between the methodology of the 24-H-RQ and the QFFQ and these should be kept in mind in the interpretation of the dietary results of this study. The 24-H-RQ provides information about the dietary intake of the children in the 24 hours preceding the administration of the questionnaire. The QFFQ, on the other hand, provides information about the children's dietary intake over a much longer period, preceding the administration of the QFFQ. In the NFCS, this period covered the preceding 6 months for children older than 2 years of age, and one month for younger children. It is, therefore, to be expected that fruit and vegetables that were not eaten in the 24 hours preceding the interview may have been eaten over the longer periods of reporting of the QFFQ. Accordingly, daily fruit and vegetable intake derived from the QFFQ was consistently higher than that obtained from the 24-H-RQ.[34]

The main use of a single 24-H-RQ is to describe the average dietary intake of groups of individuals and this tool is therefore well suited for measuring current diet in groups of subjects, particularly where differences between group means are to be evaluated, as in the NFCS and this study.[34, 57] Food frequency questionnaires are more suitable for ranking individuals by level of intake than for providing absolute estimates of intake, and are therefore said to have ranking validity.[8] However, even though the absolute values or measurements by the 24-H-RQ and QFFQ differed, similar general trends in the results were evident.

4.2 FRUIT AND VEGETABLE CONSUMPTION

4.2.1 National

Given the increasing scientific evidence that low fruit and vegetable consumption is a major risk factor for several non-communicable diseases[55], it is indeed a point of concern that children in South Africa between the ages of 12 and 108 months are not eating adequate amounts of fruit and vegetables. The mean fruit and vegetable intake per capita measured nationally was considerably lower than the 330 grams, established by the WHO (theoretical-minimum-risk distribution) for 0 - 4 year olds, not to mention the 480 grams established for 5 - 14 year olds[33] and this was found using both the 24-H-RQ (110.1 grams) and the QFFQ (204.9 grams). The mean fruit and vegetable consumption determined per 'eaters' of fruit and vegetables (data not shown) also did not meet even the lowest recommendation of 330 grams per day. The children's fruit and vegetable intake was also well below the USA MyPyramid guidelines (see Section 1.7.1 and Table 1.2) for fruit and vegetable consumption (2 - 3 year olds: 320 grams; 4 - 8 year olds: 400 - 480 grams).[48]

Inadequate consumption of fruit and vegetables has been documented as a public health concern in both the developed and developing world however, as can be expected, developing countries have a greater problem in this regard.[14, 22] A recent study by Guenther and colleagues found that most Americans eat less than the recommended amounts of fruit and vegetables. Assuming that a serving is equal to ½ cup, the USA population's mean intake of fruit and vegetables is estimated to be 4.7 ±0.1 servings per day. In children aged 2 - 3 years the estimated mean intake of fruit and vegetables was found to be 4.1 ±0.2 servings per day. Females aged between 4 and 8 years had a mean intake of 3.4 ±0.2 servings per day and males in that age group consumed 3.5 ±0.2 servings per day, on average.[14] Assuming a serving of ½ cup amounts to more or less 80 grams, the mean daily intake of fruit and vegetables in 2-3 year olds would be approximately 328 grams. This would amount to approximately 272 grams and 280 grams in 4-8 year old boys and girls, respectively. Although, the methodologies of the two studies are different, it is evident that American children eat more fruit and vegetables than South African children, which is to be expected in view of their socio-economic superiority. These fruit and vegetable intakes by children in the USA were deemed to be inadequate and this further emphasises the especially poor fruit and vegetable consumption by children in South Africa.

Studies in the literature on fruit and vegetable consumption in developing countries, and more specifically fruit and vegetable consumption in children in developing countries are scarce. In a recent survey by the WHO in sub-Saharan Africa, data on fruit and vegetable consumption was derived from a food expenditure questionnaire over a given reference period. Although not a direct

measure of consumption, these measurements were considered a fairly good proxy for consumption on average, particularly for intake of perishable food items.[22] The ten countries included in the survey were Ethiopia, Burundi, Malawi, Mozambique, Tanzania, Rwanda, Kenya, Uganda, Ghana and Guinea. The amounts of fruit and vegetables consumed (in kg per capita per year) in all these countries were well below WHO/FAO recommendation of 146 kg per capita per year (400 grams per capita per day). Intakes of fruit and vegetables ranged from the lowest in Ethiopia, at 26.7 kg per capita per year (approximately 73 grams per capita per day), to the highest in Kenya at 114 kg per capita per year (approximately 312 grams per capita per day).[22] In the 2004 WHO Comparative Quantification of Health Risks, the mean intake of fruit and vegetables was quantified by nine sub-regions globally. Estimates were based primarily on representative population-based surveys of dietary intake identified using a comprehensive literature search and data obtained was pooled statistically within each sub-region. When no survey data were available in a sub-region, per capita food supply statistics were combined with estimates of the distribution of intakes by sex and age. In the African sub-region of which South Africa was a part, the mean daily intake in children aged 0 – 4 years was 91 – 94 grams and in children aged 5 – 14 years was 181 – 193 grams per person.[33] The values obtained using these more indirect methods of fruit and vegetable consumption are comparable to the measurements obtained in this study, using the individual dietary intake methodologies and further substantiate the inadequate fruit and vegetable consumption by children in Africa.

The consumption by defined age groups (1 – 3 years; 4 – 6 years; 7 – 8.9 years) within the sample showed that total fruit and vegetable intake, fruit intake and vegetable intake increased as the children got older, but remained under 330 grams per day, indicating a poor consumption across the age spectrum. Similar percentages of children consumed fruit and vegetables across the age spectrum and problematic age groups could not be identified. More vegetable ‘eaters’ than fruit ‘eaters’ were found in all age groups, in accordance with national and provincial results.

It was difficult to establish clearly whether more fruit or more vegetables were eaten by the children since the contributions from fruit and from vegetables towards the total consumption was variable between the two dietary methodologies. In the WHO survey in sub-Saharan countries, vegetable consumption was universal in the countries studied but fruit consumption was less common and was more variable across countries.[22]

The fruit and vegetables consumed in the largest quantities by the children, (apples, bananas, orange juice, cabbage, pumpkin/butternut/hubbard squash, green leafy vegetables) are those that are generally cheaper. With the exception of pumpkin and butternut, these fruit and vegetables are

also not particularly rich sources of vitamin A, which underscores the low intakes of vitamin A found in the NFCS and also the marginal vitamin A status documented in one in three children nationally, in the South African Vitamin A Consultative Group (SAVACG) study.[34, 58] In the NFCS, fruits other than those rich in vitamin A or vitamin C, which would include apples and bananas, were found to be among the top 25 food items consumed and procured most frequently in households. Similarly, cabbage, green leafy vegetables and pumpkin were found to be among the top 25 food items consumed.[34]

When evaluating the percentage of children eating fruit and vegetables ('eaters'), it is perhaps more relevant to consider the results from the QFFQ data and to interpret these findings in conjunction with the frequency of intake of fruit and vegetable measured by this questionnaire. The reason for this is that the QFFQ provides a better impression of intake over a longer period of time. Use of the 24-H-RQ for this purpose, would mean that if children did not eat fruit and/or vegetables on the day prior to the administration of the 24-H-RQ, they would not have been measured as 'eaters', which could possibly result in unreliably low percentages of fruit and vegetables 'eaters'.

The QFFQ results show that fruit and/or vegetables are eaten by most South African children and that more children consume vegetables than fruit. Nationally, the frequency of intake of fruit and vegetables is low (2.16 times per day). The same low frequency of fruit and vegetable consumption was seen across all age groups. Fruit is not eaten every day by all children (0.81 times) and vegetables are eaten approximately once daily (1.34 times) on average. These results are in accordance with the low fruit and vegetable intakes found nationally.

It is alarming to note that according to these findings, there are children who did not eat any fruit and/or vegetables in the month preceding the QFFQ interview for 1 to 2 year olds and in the 6 months preceding the QFFQ interview for the older children. Micronutrient malnutrition remains one of the largest nutritional problems globally, affecting people in both developed and developing countries.[59] In all likelihood these children's diets have a low dietary diversity and for vulnerable infants and young children, lack of dietary diversity is particularly critical because they need energy- and nutrient-dense foods for growth and development, both physically and mentally.[26] Increasing the diversity of foods provided to young children, particularly meat, poultry, fish, eggs, fruit and vegetables, is recommended to improve micronutrient intakes.[60]

A recent study based on the NFCS data revealed similar findings in terms of the percentage of children that ate fruit and vegetables daily. The authors stated that their results suggest that there is

an acceptance of the consumption of fruit and vegetables and that intake is limited by factors such as low availability and access.[31] These findings are supported by the results of this study.

The food inventory data from the NFCS showed that the top six food items most often found in the low income households were maize, white sugar, salt, tea, whole milk and hard margarine/cooking fat. It is impossible to provide sufficient micronutrients to meet the needs of children using these food items. Thus, in terms of dietary quality, it can be said that food insecurity in South Africa is relevant to micronutrients also. This is substantiated by the low micronutrient consumption reflected by the 24-H-RQ and the QFFQ.[34] A recent secondary analysis of the NFCS data of 1999, found that in comparison to other developing nations, the diet of South African children has a low food variety score and dietary diversity score. This may be partly due to the dietary methodology employed in this survey; however, the authors do highlight the fact that dietary variety is very limited in the majority of South African children's diets.[61] The foods described in a qualitative study by Coutsoudis *et al*, also indicated a monotonous diet, lacking variety and consisting primarily of cereals and occasionally animal foods.[62] The low fruit and vegetable consumption found nationally and provincially in this study would contribute to this poor micronutrient intake and low dietary diversity and would play a significant role in the household micronutrient insecurity.

4.2.2 Provincial

Intakes of fruit and vegetables were low in all provinces and also varied greatly between provinces. Percentages of 'eaters' and frequency of consumption also varied across the provinces. In accordance with national findings, the percentage of fruit 'eaters' was lower than the percentage of vegetable 'eaters' in all provinces with the exception of the Western Cape, where equal percentages were found by the QFFQ. Factors which could play a role in this variation include the differential socio-economic development and wealth in the various provinces, as well as the diversity in climates and access to water, which would influence provincial fruit and vegetable production, prices, availability and accessibility of these foods. For example, children in the Western Cape had a higher fruit and vegetable intake and this province is more socio-economically and agriculturally developed, has areas of high rainfall and produces vast amounts of fruit and vegetables. On the other hand, the Northern Cape had very low fruit and vegetable consumption levels and this province is less socio-economically developed, has low rainfall and very arid and remote regions, resulting in poor availability of fruit and vegetables and higher prices associated with transport costs. According to the NFCS, the provinces with more than 30% of households that reported an income in the lowest range included the Eastern Cape, the Free State, KwaZulu/Natal, the Northern Cape and the North West.[34] The lowest consumption of fruit and vegetables were found in these poorer provinces. Cultural

differences between the people of the different provinces could also explain some of the variable fruit and vegetable consumption observed.

4.2.3 Anthropometry

Weight-for-age status was related to fruit and vegetable consumption and underweight children (< -2 SD WAZ) ate less fruit and vegetables, fruit, and vegetables. Weight-for-height was shown to be related to fruit and vegetable intake, with wasted children generally eating less fruit and vegetables. The general tendency was that significantly fewer underweight (< -2 SD WAZ) children consumed fruit and vegetables and also consumed them less frequently and wasted children (< -2 SD WHZ) also consumed fruit and vegetables significantly less frequently. These findings correlate with the significantly lower energy intake by underweight and wasted children, indicating that these children ate less food in total per day, including less fruit and vegetables, than children who were not underweight or wasted. The problems of undernutrition, household food insecurity, micronutrient insecurity and poor dietary diversity amongst children in South Africa have been documented.[34, 61] Although all children in South Africa have inadequate fruit and vegetable intakes, the undernourished seem to have an even lower intake.

On the other hand, an important public health concern is the increasing prevalence of childhood obesity, both in industrialized and developing nations, including South Africa.[61] Childhood and adolescence are critical periods for individuals to lay the foundation for their future good health and are also important periods in the development of obesity, since a large proportion of children track their dietary intake patterns from childhood into adolescence. A study in China found that nearly half of children who initially consumed a high fruit and vegetable diet still consumed such a diet 6 years later when they became adolescents. Similarly, a large proportion of children initially consuming a high fat diet continue with this type of diet into adolescence.[63] This study confirmed findings regarding tracking of fruit and vegetable intake over time in children by Resnicow *et al*.[64] Studies in developed nations have shown that children are not eating enough fruit and vegetables and have diets high in sugar, fat and refined carbohydrates, which is a dietary pattern associated with the growing obesity problem and is also a contributing factor in many chronic diseases.[65]

In this study, overweight children (> +2 SD WAZ) had higher mean fruit and vegetable intakes than children with a normal WAZ, but the intakes by overweight children were still lower than the levels, established by the WHO[33] and the USA MyPyramid guidelines.[48]

Primary determinants of dietary intake in food secure households differ from those in lower income households. Research in affluent countries has shown that the environmental determinants of fruit

and vegetable intake in children include parental fruit and vegetable intake, knowledge of intake recommendations and media exposure.[66] Therefore, in higher income homes, poor food choices are more likely to lead to diets high in sugar, fat and refined carbohydrates and low in fruit and vegetables. In lower income homes however, the primary determinant of dietary intake is more likely to be the price of food. Darmon and colleagues found that a simple cost constraint influences food selection in such a way that nutrient densities decrease and this suggests that economic constraints may result in the nutritional inadequacy and unhealthy eating patterns often documented in lower socio-economic groups. Their study provided evidence that a cost constraint on the food budget may result in the selection of foods with a low micronutrient density, independent of other factors.[67] With the exception of some fat-soluble nutrients, a reduction in diet cost was associated with a decrease in nutrient density. This decline was especially visible for vitamin C and β-carotene, implying that these nutrients are specifically sensitive to poverty. This research highlights a critical public health issue since it suggests that nutrition education on its own may be ineffective if not combined with economic interventions directed at improving the affordability and accessibility of a healthy diet.[67]

Drewnoski *et al* found that lower prices per calorie for energy dense foods contribute to higher obesity rates in low income populations.[68] Higher food prices may lead to consumption of foods with higher energy density, which cost less for the same amount of calories than fresh fruit and vegetables and energy density has been implicated as a cause of obesity.[69] Sturm *et al* have shown that relative food prices are associated with changes in the BMI and obesity rates, and the relationship is significant and robust for fruit and vegetable prices in that higher fruit and vegetable prices predict greater BMI increase. Although not significant, their results suggest a protective effect, (i.e. lower weight gain), of lower fruit and vegetable prices is 1.5 times larger for poor children than for other children. Thus increases in fruit and vegetable consumption may be the most beneficial for children who consume the least.[69]

4.2.4 Socio-economics

A very significant percentage of South Africa's population live under adverse socio-economic conditions and about 48.5% of the South African population currently fall below the national poverty line.[70] The very poor particularly include African, female-headed and rural households.[71] Low fruit and vegetable consumption, which result in suboptimal nutrient intakes, particularly for vitamin C and β-carotene, has been consistently found in low socio-economic groups.[67] Research in a number of developed countries has established that families who are less affluent, less educated, or work in less prestigious jobs, have diets that are least concordant with official recommendations, both in general and specifically in relation to fruit and vegetables. Understanding reasons for these differences in fruit and vegetable consumption between socio-economic groups is an important public

health issue. In order to examine and explain socio-economic differences in dietary intake, it is essential to consider both the environmental characteristics and individual factors that impact on dietary intake.[72, 73] The socio-economic indicators that were examined in relation to fruit and vegetable consumption were head of household, household income and the education level of the mother.

4.2.4.1 Head of household

Research into the effect of head of household on fruit and vegetable intake has yielded variable results.[22] No consistent and strong associations were found between head of household and fruit and vegetable consumption in this study. However, there was a trend for children in father-headed households to have better total intakes of fruit and vegetables and better fruit intakes. Higher proportions of fruit and vegetable 'eaters' and fruit 'eaters', and more frequent intakes of fruit and vegetables and of fruit, were also found in father-headed homes. The better consumption in father-headed households could be due to a greater monthly income earned by males. These associations were not observed for vegetable consumption, which could be explained by the fact that vegetables are generally less expensive than fruit. Although statistically significant, it is unlikely that the slightly greater percentage of fruit and vegetable 'eaters' found grandfather-headed households in comparison to mother-headed households, has any clinical or practical significance.

A review of the determinants of fruit and vegetable consumption among 6 - 12 year old children found that availability; accessibility and taste preferences were the strongest predictors of consumption.[66] Parental fruit and vegetable intake, knowledge of intake recommendations and skills also had a positive association with children's consumption.[66] Similarly, a study in the United Kingdom found that parental control was correlated with children's fruit and vegetable intake and there were no significant sex differences.[65] Parental fruit and vegetable intake and children's food neophobia were strong predictors of consumption of fruit and vegetables by children, and both were associated with parental control.[65] In low income households, the factors that affect what people are able to purchase and consume influence the diet more strongly than factors that affect what people choose to purchase or consume. Low income households must first satisfy their physiological hunger by buying and consuming cheap energy sources.[22] The relationship between the head of the household and fruit and vegetable intake by children would therefore be different in a low income household in comparison to a more affluent household. In low income homes, the affordability of fruit and vegetables by the breadwinner would directly determine the availability and accessibility of fruit and vegetables to all members of the household. This was confirmed by Ard *et al*, who found that higher income was positively related to availability of fruit and vegetables in the homes of schoolchildren in the United States.[74]

4.2.4.2 Household income

A large body of evidence supports the roles of economic factors in food selection and dietary quality evaluated by global index, has been shown to decrease when less funds are spent on food. Undoubtedly, food prices are an important determinant of food choice, especially among low income segments and the unemployed.[67] A study by Darmon and colleagues implies that the food budget directly affects food selection and therefore quality of the diet. This evidence supports other studies which have shown nutrition education in combination with an economic measure is more effective than nutrition education alone in increasing fruit and vegetable intake. Similarly, economic analysis shows that fresh fruit and vegetables and meats have high income elasticity, meaning that when income changes with one percentage, the percentage changes in the demand for these foods is high. Staple foods however, have low income elasticity.[67] Increases in income are associated with larger rises in the demand for fruit and vegetables in poorer countries in comparison to more affluent countries.[22]

In low income households, a need to avoid hunger exists and these people must make meeting their basic energy needs a priority. Furthermore, low income households are more sensitive to prices than high income households.[22] Food purchases based on price concerns, in contrast to nutritional value, tend to be energy-rich and nutrient-poor. Cost, determined on a per calorie basis, makes fruit and vegetables a great deal more expensive in comparison to fats and sweets, whilst refined cereals, added fats and added sugars provide dietary energy at a low cost.[37] This largely explains why the demand for fruit and vegetables is small in these households. The fact that fruit and vegetables are an expensive source of energy is therefore a key constraint to the consumption of these foods in near-subsistence households.[40] Additionally, protein and fat need to be added to the diet and non-food supplies and services are also required, which leaves little earnings for fruit and vegetables.[22] In a systematic review of the environmental determinants of fruit and vegetable consumption among adults, Kamphuis *et al* found the most evidence for household income, as people with lower household incomes consistently had a lower fruit and vegetable consumption.[75] In the WHO survey by Ruel *et al* in sub-Saharan Africa, there was a general positive trend of increasing consumption of fruit and vegetables as gross domestic product increased, but this trend was not fully linear.[22]

The majority of households in South African are low income.[70] In accordance with previous findings, a clear correlation was seen between household income and total fruit and vegetable intake, and fruit intake in this study. Families with greater monthly incomes had significantly better intakes than the poorer households. Accordingly, a greater proportion of children in homes with better monthly earnings consumed these plant foods and in particular, consumed fruit, and this consumption was

also more frequent than in the poorer households. No associations were found between vegetable intake and household income. Higher income in developing countries, is not only associated with an increase in the amount of fruit and vegetables consumed, but also with an increase in the diversity of fruit and vegetables that are eaten.[22]

4.2.4.3 Education level

The highest education levels of parents are often used as an index of household socio-economic status and family income.[76] Higher income groups are seen as having higher education levels or an increased awareness of health-related issues and this has been used to explain the effect of socio-economic variables on the quality of dietary intake.[68] People with higher education are seen as being more likely to adopt healthier dietary habits and affect their children's awareness of the quality and quantity of their food selection.[76] Research in the United States, has suggested a linear trend in subjects' level of education and fruit and vegetable intake.[77] Higher socio-economic status, indexed by either occupational status or level of education, has been positively related to fruit and vegetable intakes, both in adolescents and adults.[78] In keeping with these assertions, more fruit and vegetables were being consumed more frequently by children whose mothers had formal education and in particular in the households where mothers had a tertiary education. The proportions of children consuming fruit and vegetables was also greater amongst children whose mothers had more formal education and this was more evident for fruit 'eaters'. The higher consumption of fruit and vegetables by children of more formally educated mothers may be due to these mothers having an increased nutritional knowledge or awareness of health. It may also be due to these mothers earning more and consequently there being a greater availability of fruit and vegetables in the household. Vegetable intake by the children was not affected by the education level of the mothers.

4.3 PROCUREMENT OF FRUIT AND VEGETABLES

4.3.1 National and provincial

In South Africa, it is generally accepted that there is national food security but not household food security.[34, 79] Food needs to be available, accessible and affordable to households, in order for there to be household food security.[62] Food consumption patterns are closely linked to food procurement and purchasing patterns. When evaluating food intake, as with fruit and vegetables in this case, it is important to consider how people obtain the food they eat. Food is procured in various ways, including purchasing, growing and gathering. For those that are food insecure, food procurement sources and survival methods also include borrowing and asking for money or food from friends and/or neighbours.[62] A qualitative study in an urban-informal settlement and a rural settlement in

Kwazulu-Natal in South Africa, conducted as part of a WHO Multicountry study, suggested that most of the food that enters the household for consumption is purchased.[62] Similarly, the NFCS found that most households procured the most commonly consumed food items by purchasing them.[34] The most common source of procurement of fruit and vegetables by households nationally in this study was also by purchase (90.2 % of households). Subsistence farming of fruit and vegetables, of fruit, and of vegetables was practiced by only small percentages of households nationally, with more households growing vegetables (8.2 %) for their consumption than fruit (1.5 %). The proportion of households cultivating fruit and vegetables varied between provinces with Limpopo, KwaZulu-Natal, the Eastern Cape and the Free State having the greater percentages of households practicing subsistence farming of fruit and vegetables. Limpopo was the only province with a noteworthy percentage of households growing fruit. Coutsoudis *et al* found several constraints to food cultivation, including seasonality of production, water shortages, and loss of crops damaged by livestock due to lack of fencing, which is not affordable.[62] Frequency of purchase of fruit and vegetables, of fruit, and of vegetables showed a similar trend nationally and provincially, with most households purchasing these plant foods on a weekly and fortnightly basis.

4.3.2 Socio-economics

4.3.2.1 Head of household

Purchasing was the most common form of procurement of fruit and vegetables, of fruit, and of vegetables, with no noteworthy trends in terms of household headship. Cultivation of fruit and vegetables and of vegetables occurred in more households where the grandfather or grandmother was the head, possibly due to the influence of more traditional food procurement methods, which were used more frequently in the past. This could also be due to grandparents not working away from the home and therefore having the time to plant and tend to food gardens during the day.

4.3.2.2 Household income

According to the NFCS, the national average number of food items procured by households in the NFCS was 35 and this number varied from 16 in the Free State to 67 in the Western Cape. Lower income households procured a significantly lower mean number of food items when compared with households with higher incomes. Household income emerged as the most significant factor in the consumption and procurement of food in the NFCS and it was clear that this affects the variety of foods included in the diet.[34] In all households across the income spectrum, fruit and vegetable procurement occurred mostly by purchase. However, more of the poorer households cultivated their own fruit and vegetables and households practicing subsistence farming decreased as affluence increased. In food insecure households, food shortages would demand the need to get food in other

ways, which would include trying to growing their own food. In households with all levels of income, similar trends in terms of frequency of purchase of fruit and vegetables were observed; however, more of the poorest households purchased these foods on special occasions. In the research by Coutsoudis *et al*, responses suggested that purchasing was dependent on when money was available, access to shops, the return of migrant husbands and the availability of storage facilities. Food shortages were reported by all groups and borrowing and asking for food from friends and/or neighbours was frequent and widespread. The decisive determinant of the occurrence of food shortages was the frequency with which money came in for household requirements and the amount of money. Even when the women in the study had a good knowledge of the types of foods that would keep their children healthy, they had no money to buy these foods.[62] This again indicates that poverty is a major constraint to adequate food procurement, dietary consumption and household food security in South Africa.

4.3.2.3 Education level

In all households and with mothers having any education level, purchasing was the most common method of procurement of fruit and vegetables. More households where mothers had a lower level of education cultivated their own fruit and vegetables. Lower socio-economic households are more likely to be food insecure, which creates the necessity for these households to procure foods in other ways. Fruit was purchased more frequently on special occasions by households where the mothers had no formal education. Fruit may be seen as a luxury, due to its higher cost and this may explain why purchasing of fruit is reserved for special events.

4.4 INTERVENTIONS

A recent review confirmed previous findings that have identified the need for interventions to promote fruit and vegetable intake across childhood and adolescence. Based on the majority of available evidence, interventions to promote fruit and vegetable intake should be aimed at children from lower socio-economic positions.[39] A systematic review of interventions to increase fruit and vegetable intake in children, found that 10 out of 15 studies had a significant effect, with increases in fruit and vegetables ranging 0.3 to 0.99 servings per day. The studies that met the criteria and were thus included, represent only a very small sample of developed countries and the results are therefore mostly relevant to developed settings.[19] Some evidence indicates that in order to increase average fruit and vegetable consumption towards the recommended levels, interventions should also focus on encouraging an increase in frequency of consumption.[8]

Nutrition education aimed at improving fruit and vegetable intake is imperative for promoting good health, especially within an environment where poor fruit and vegetable consumption has been documented. The South African Food Based Dietary Guidelines is the South African government's primary nutrition education initiative and contains a guideline regarding fruit and vegetable consumption, namely "Eat plenty of fruit and vegetables every day". When dietary guidelines are communicated to the public, it would be helpful if descriptions of portion sizes were to accompany these guidelines, in the form of dietary goals, for example. In some countries, quantitative recommendations for portions or servings are provided in the national dietary guidelines without a definition of what such a portion or serving amounts to. In other countries, the quantitative recommendation is provided along with the public guidelines.[8] In South Africa as in many other nations, the national dietary guidelines make only a qualitative statement with regard to fruit and vegetable intake.[80] Preliminary reports from the South African Pediatric Food Based Dietary Guideline Working Group show that the guidelines for children aged 1 to 7 years will most likely follow the qualitative approach of the national guidelines launched for South Africans older than 7 years.[81] According to the literature, food guidelines should also make recommendations regarding the need for people to consume a variety of fruit and vegetables. This is not only to promote the nutritional quality of the diet, but by increasing variety, the likelihood for increased total intake is increased.[8] The importance of this nutrition education strategy by the government is vital but it is well known that education on its own does not result in dietary changes.[36]

Interventions to improve fruit and vegetable consumption should aim at changing availability and accessibility of these plant foods, but it is also important to realise that personal, social and environmental factors all influence behaviour change.[82, 83] A recent study, which evaluated multi-component school interventions to increase fruit and vegetable intake in the United States, found that overall these interventions have been effective in increasing fruit intake. Vegetable intake has proven more difficult to change. Most of these programs included classroom education and behaviour change curricula, foodservice changes and a parent home activity component.[84] In implementing a school fruit and vegetable program, it would therefore be necessary to consider combining the supply of fruit and vegetables at schools with other educational and behavioural components. According to the Micronutrient Initiative Global Progress Report, strategies aimed at improving dietary quality should be initiated and supported by governments. Projects that support the growth and consumption of a wider variety of foods by families and communities should be considered, as a practical and affordable method of contributing towards the fight against vitamin and mineral deficiencies.[25] A study in Norway found that providing fruit and vegetables to all pupils at school and at no cost to their parents is an effective strategy to increase children's overall fruit and vegetable intake. This free programme seemed to increase fruit and vegetable consumption for all groups of school children,

including children of families with lower socio-economic status and those with low baseline intakes.[82] The infrastructure of the current school-feeding program in South Africa, which provides mainly carbohydrates and some protein, could be used for the implementation of a school fruit and/or vegetable program by providing at least one portion of fruit and/or vegetables daily.

The Health Promoting Schools (HPS) model, based on the Ottawa Charter for Health Promotion, refers to the strategies designed to promote health and reduce disease in schools. The conceptual framework proposed by the HPS movement was adopted in South Africa in order to address school health comprehensively.[85] It would be feasible to include strategies that aim to improve fruit and vegetable intake in the current HPS system. The HPS model could be used as a vehicle for the introduction of food gardening programmes in school settings. This could complement school feeding programs and promote nutrition education through actively engaging the learners in gardening practices and school lessons with a nutrition focus. This approach would improve the availability of fruit and vegetables to school children in combination with educational and behavioural interventions.

The 5-a-Day for Better Health Trust is a non-profit organisation, which was launched in South Africa in September 2005. With sound scientific backing, it aims to increase the consumption of fruit and vegetables through education and promotion in order to promote better health. The Trust has formed a good working relationship with the Nutrition Directorate, DOH. A number of joint projects have been launched and the government supports 5-a-Day, with both parties promoting the overall message of 'eat plenty' and 'eat a variety' in line with the South African Food Based Dietary Guidelines. (personal written communication with Jane Badham, Chief Executive Officer of the 5-a-Day for Better Health Trust, on 01 March 2007) Furthermore, the 5-a-Day message supports and complements the food based dietary guideline relating to fruit and vegetable intake, by providing a quantitative description of 'eat plenty'.

4.5 LIMITATIONS

The limitations of this study relate mainly to the inherent limitations of the dietary methodologies employed, which include weakness of data-gathering techniques, human behaviour, the natural tendency of an individual's diet to vary considerably from day to day, as well as the limitations of food composition databases.[57] In an attempt to overcome some of these limitations, all efforts were made to ensure validity and reliability of the data collection questionnaires.[34] Although absolute measurements may not be completely accurate due to these limitations and the measurement error

that occurs with all measurements, the methodologies used were able provide a fairly reliable indication of fruit and vegetable consumption and the related factors that were examined.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSIONS AND RECOMMENDATIONS

Research has indicated that many eating behaviours are initiated in childhood, track over the childhood years and persist into adulthood. Thus starting with healthier and disease preventive dietary habits could provide life-long benefits.[78] In view of the very poor fruit and vegetable consumption described in this study and the other relevant scientific research discussed, the importance of adequate fruit and vegetable consumption by children in South Africa, both in terms of disease prevention and micronutrient security cannot be ignored. In addressing the problem of healthful nutrition and dietary intake, and more specifically the issue of inadequate fruit and vegetable consumption, it would be necessary to consider interventions in both the micro- and the macro-environments in which the population lives.

The very poor consumption of fruit and vegetables and the low frequency of fruit and vegetable consumption, in combination with the adverse socio-economic conditions and the household food and micronutrient insecurity in South Africa, calls for more direct, household and individual interventions to address this concern. Studies have shown that interventions to improve fruit and vegetable intake in children should aim to improve the availability of these foods in school environments and should aim to improve preferences for fruit and vegetables.[39] With this in mind and the plentiful literature regarding school fruit and vegetable programs, the implementation of a school fruit and/or vegetable program by the South African government needs due consideration. A recommendation from the NFCS is that supplementary foods provided by government should be re-evaluated and modified if necessary. The focus should not be merely on their energy content but also on micronutrient composition and dietary quality.[34] A school fruit and/or vegetable program may contribute to achieving this valid recommendation. An efficient school fruit and/or vegetable program would support the promotion of fruit and vegetable intake in children and assist in improving the nutritional and health status of children in South Africa. It would be viable to use the infrastructure provided by the current school-feeding program, together with the HPS model, for the implementation of a program of this nature in South Africa.

Additionally, the role of effective nutrition education in improving fruit and vegetable intake, within the available financial setting, should not be underestimated and should be continued and developed within the national, provincial and local health structures in the country. Good household practices in relation to food procurement and household resource allocation can make the best use of existing resources to promote better health and nutrition in young children.[62] However, in considering the bigger picture within our country, it is necessary to realise that the broader food environment must support individuals in making healthful food choices, amongst all income levels.[36] The association

between fruit and vegetable intake and income was very apparent in this study and it is known that improving food choices is much more difficult among low income individuals. The recommendation for low-socio-economic families to increase their consumption of more nutrient dense but more costly foods is not only discerning but reveals a lack of understanding of the role that the general food environment plays in affecting food choices. It is therefore also important to mention that the political and economic food policies, which include food trade, tariffs and agricultural subsidies, contribute to the relatively low cost of high energy-dense foods and the relatively high cost of low energy-dense foods, such as fruit and vegetables.[36] Intervention beyond the individual level is fundamental if low energy-dense and healthful diets are to really promote public health. International and national interventions to food policies are needed to ensure that healthful foods are accessible and affordable to individuals of all income levels. The food industry can contribute by creating low energy-dense foods that are well priced and palatable.[36] In the USA, it has been found that a 10 percent reduction in fruit and vegetable prices increases consumption by 7.2 percent.[69] Policies to reduce market prices of fruit and vegetables can have an important impact on fruit and vegetable intake, especially in low income households.[22] The importance of income in determining dietary intake has been demonstrated and discussed, however, it remains important to remember that other factors, for example exposure to the media and health consciousness of parents, also play an important role in children's dietary intake beyond the determining role of family resources and access to foods in developing nations, undergoing rapid social and economic transitions.[63] The USA 5-A-Day program aims to increase the population's consumption of fruit and vegetables to five or more servings per day, using four major components, namely retail, community, media and research.[84] Responsible and effective strategies to increase fruit and vegetable intake by media and other relevant sectors in South Africa are needed.

It would be beneficial for the South African government to continue and expand its current collaboration with the 5-a-Day for Better Health Trust. Additionally, the government could foster the relationships between the 5-a-Day program, the INP and other participatory sectors, which would support the growth, implementation and efficacy of this intervention.

Approximately a third of the South African population is under the age of 15 years of age and investing in the health and diets of these children needs to be a priority in terms of the future development of this great country.

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APPENDIX 1

Examples of the questionnaires used in the NFCS are available at:
http://www.sahealthinfo.org/nutrition/foodconsumption.htm