REPORT ON SOUTH AFRICAN FOOD CONSUMPTION STUDIES UNDERTAKEN AMONGST DIFFERENT POPULATION GROUPS (1983 – 2000): AVERAGE INTAKES OF FOODS MOST COMMONLY CONSUMED

Johanna Helena Nel (DSc)
(BB and A Hons)(Pr.Sci.Nat.)

AND

Nelia Patricia Steyn (PhD)(RD SA)

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MRS ANNETTE CASEY
(DEPARTMENT OF HEALTH, DIRECTORATE: FOOD CONTROL) AND
DR CARL LOMBARD (BIOSTATISTICS, MEDICAL RESEARCH COUNCIL)

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All comments and queries emanating from this report should be directed to:

The Department of Health
Directorate: Food Control
Private Bag X828
PRETORIA
0001
South Africa

Tel: 27 12 312 0155

Fax: 27 12 326 4374

e-mail: caseya@health.gov.za

FOREWORD

This study, commissioned by the Directorate: Food Control of the Department of Health, fulfils a very important mission in the area of general health of the South African population. The Directorate: Food Control has undertaken to evaluate (by analysis) the levels of contaminants found in South African foods and beverages in order to ensure that South African standards conform to the regulations stipulated in the Codex Allimentarius regulations of the World Health Organisation. The selection of food items to be finally tested for this purpose will be based on the outcomes of this report.

In 1999, the first ever National Food Consumption Survey in children was undertaken in South Africa. The survey gave comprehensive results on the dietary intake and nutritional status of children representative of the South African population in the age group 1 - 9 years old. The survey determined the actual food intake (and portion sizes) of foods commonly consumed by children. However, there are no similar national data available for adult South Africans. The latter posed a dilemma for the Directorate: Food Control, since the Directorate was required to undertake the chemical analyses of foods commonly consumed, and food portions thereof, by both adults and children. Hence, this commissioned study.

This report has successfully meta-analysed some of the main dietary surveys undertaken in South Africa over the past two decades. Although dietary surveys are known to be fraught with many methodological limitations, this report has combined a series of statistical techniques in a logical sequence in order to estimate the usual food consumption of adults and children in both urban and rural areas. From a health perspective, this study adds considerably to the dietary knowledge base in South Africa.

Prof Demetre Labadarios
Head: Department of Human Nutrition
University of Stellenbosch
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Liquid Consumption Survey: Bourne LT.

GEMS/Food Regional Diets: Moy G.

Eurocode 99/2: Unwin ID.

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LIST OF ABBREVIATIONS

ADI	Acceptable Daily Intake
BRISK	Risk Factor Study in the urban black population of Cape Town (also Black Risk Factor Study)
CORIS	Coronary Risk Factor Study
EURO Codes	European countries classification of food items
FAO	Food and Agriculture Organization of the United Nations

FFREQ	Food frequency dietary method
FYFS	First Year Female Students
GEMS/Food:	Global Environment Monitoring System/Food Contamination Monitoring and Assessment Programme
24HR	24-hour recall dietary method
MRL	Maximum Residue Limit
NFCS	National Food Consumption Survey
RSA	Republic of South Africa – Provinces follow:
EC	Eastern Cape
FS	Free State
GP	Gauteng Province
KZ	KwaZulu-Natal
MP	Mpumalanga
NC	Northern Cape
NP	Northern Province
NW	North West Province
WC	Western Cape
SAS	Statistical Analysis Software
TDS	Total Diet Study
THUSA	Transition, Health and Urbanization in South Africa
THUSA Bana	Transition, Health and Urbanization in South Africa for children, also meaning "Help the children" in Setswana, the regional language
TMDI	Theoretical Maximum Daily Intake
UNEP	United Nations Environment Programme
USFDA	United States Food and Drug Administration
WHO	World Health Organization
WRFS	Weight and Risk Factor Study

LIST OF DEFINITIONS

ADI: "The ADI of a chemical is the estimate of the amount of a substance in food or drinking water, expressed on a body-weight basis, that can be ingested daily over a lifetime without appreciable health risk to the consumer on the basis of all the known facts at the time of the evaluation" (WHO 1997(b): 20).

MRL: "A codex MRL for pesticide residues is the maximum concentration of a pesticide residue (expressed as mg/kg), recommended by the Codex Alimentarius Commission to be legally permitted in or on food commodities and animal feed" (WHO 1997(b): 20).

TMDI: "The TMDI is a prediction of the maximum daily intake of a pesticide residue, assuming that residues are present at the MRLs and that average daily consumption of foods per person is represented by regional diets" (WHO 1997(b): 24).

Food items: Descriptive term used in this report to describe foods, beverages, and water.

1. EXECUTIVE SUMMARY

The primary objective of this study was to generate a reference table of "most commonly" consumed food items and average intakes of these items in the diet of South Africans. The table is required to be representative of foods eaten by children and adults from all age and ethnic groups in South Africa. The table will serve as a reference table for the Department of Health who would undertake analyses of (a) toxic chemicals, such as pesticides, heavy metals and environmental contaminants; (b) naturally occurring toxins; and (c) food additives in the commonly consumed food items. The goal is to estimate the actual dietary intake of toxic chemicals, naturally occurring toxins and food additives for comparison with their corresponding toxicological reference intakes, such as the Acceptable Daily Intake (ADI) or provisional tolerable weekly intake (PTWI). A secondary objective of the study was to derive average (mean) weights of South Africans in different age groups in order for the calculation of dietary exposure of selected contaminants according to:

*Dietary Exposure=(Food Chemical Concentration*Consumption)/(Body Weight).*

Secondary data-analysis was conducted on existing dietary databases (raw data) obtained from surveys undertaken in South Africa between 1983 and 2000. The National Food Consumption Survey (NFCS) served as a framework for compiling data on children since this was a national representative survey of 1-9 year-old children in South Africa. However there has never been a national dietary survey on adults in South Africa. Consequently the data had to be extrapolated from existing isolated surveys on adults. In this process the following databases were utilised: Lebowa Study; Dikgale Study; Black Risk Factor Study (BRISK); Transition, Health and Urbanisation Study (THUSA); THUSA Bana Study; First Year Female Student (FYFS) Project; Weight and Risk Factor Study (WRFS); and the Coronary Risk Factor Study (CORIS). The dietary intake for the groups 1-5 years and 6-9 years were calculated only from the NFCS, and were not supplemented by other databases. The substantiation for treating age 10+ as a unit (and calling it an adult group), was the finding that average consumption of adolescents (10 – 15 years) did not differ significantly from that of adults when comparing mean energy intakes of age groups in the studies analysed.

It is important to evaluate the results of this report in the context of the databases used. The estimates generated represent crude portions of food items consumed and should not be compared with the methods generally used in dietary surveys to evaluate macro- and micro-nutrient intakes of specific age groups. Although an attempt was made to include as many databases as possible to represent the average South African population, it was not realistic or feasible to include every study which has been undertaken in the specified period

The dietary data from different studies were firstly coded into GEMS/Food Commodities (main food groups); then into GEMS/Food subgroups; then into food items having a description and a method of processing (i.e. dried/canned/fresh). The latter step involved utilising the MRC food groups and the EURO codes. The final tables generated comprised the following data with regard to food items consumed: main food group (i.e. cereals); the subgroup

where appropriate (i.e. maize); a description of the item where appropriate (i.e. maize porridge); the percentage of the sample consuming that item; the portion consumed per day by those individuals who actually consumed the item and the average portion (per capita) consumed per day by all individuals in the relevant sample. The latter portion is smaller because it represents the total quantity consumed divided by the size of the relevant sample.

The procedures used to generate adult data were based on factor analyses of all databases. Data were analysed in terms of percentage of the group consuming specific food subgroups/main groups/food items and on average per capita portion size. Factor analyses were done to establish the relationship between NFCS 6-9 year-olds in 9 provinces, urban and rural separately, with those databases having adult participants, namely: BRISK, Lebowa Study, CORIS urban and rural (adults), Dikgale Study (adults) and THUSA Bana (urban and rural).

The results implied that Factor 1 reflected portion size and Factor 2 variety of items consumed. Dikgale and Lebowa data clustered together with most NFCS rural groups to form a group (group 1). CORIS, BRISK and the Western Cape NFCS data clustered together (group 2). Data of the main urban areas clustered together in a third corresponding group (group 3), which lay between Lebowa/Dikgale on the one hand and BRISK on the other hand. Group 1 was regarded as the cluster of studies that consumed large portions of food (specifically maize) and included: Northern Province (urban and rural), Free State (urban and rural), North West (urban and rural) and rural areas of Mpumalanga, Eastern Cape, Gauteng, and KwaZulu-Natal. Group 2 on the other hand included studies where participants consumed smaller portion sizes yet consumed a large variety of food items. This group included the Western Cape urban and rural areas. Group 3 formed a cluster, which lay between group 1 and 2. Group 3 included all the remaining urban areas: Gauteng, Eastern Cape, KwaZulu-Natal, Mpumalanga and Northern Cape.

Equations were developed to determine combined estimates for different population groups by 2 different methods.

Method 1:
Estimation of group 1: adult consumption was estimated by taking the average values of Dikgale and Lebowa adult data. This data formed a pivotal point of Group 1. Dikgale and Lebowa data complemented each other, since the latter included adolescents and the former adults.

Estimation of Group 2: CORIS data represented the white population of the Western Cape, and BRISK data represented the black population of the Western Cape. Because of the similarities between CORIS urban and rural data, the combined databases were used in further analyses. It was accepted that white and "coloured" populations in Western Cape have similar dietary patterns (Steyn 1988). Adult dietary intake for the Western Cape were calculated as the weighted average of CORIS and BRISK data, using the ratio of black versus non-black residents in the Western Cape as described in Census 1996 data (Central Statistical Services 1999).

Estimation of Group 3: The average of BRISK and the combined average of Lebowa and Dikgale data were used to estimate adult consumption for this group.

Urban and rural intakes were combined to produce a single adult estimate per province, using the ratios between urban and rural per province, as calculated from the 1996 Census data. Adult intakes (average per capita portion size and percentage of adults consuming the item) in South Africa (RSA) were estimated by applying weights according to the proportion of populations in each province (Central Statistical Services 1999), as follows:

*RSA =0.155*EC + 0.065*FS + 0.181*GP + 0.207*KZ + 0.069*MP + 0.021*NC + 0.122*NP + 0.083*NW + 0.097*WC;*

*RSA(rural) = 0.21*EC + 0.05*FS + 0.01*GP + 0.26*KZ + 0.09*MP + 0.01*NC + 0.23*NP + 0.12*NW + 0.02*WC;*

*RSA(urban) = 0.11*EC + 0.08*FS + 0.33*GP + 0.17*KZ + 0.05*MP +0.03*NC + 0.02*NP + 0.05*NW + 0.16*WC.*

This equations were further simplified and adjusted for sample size, in terms of the original databases to:

*RSA = 4.365*Lebowa + 5.901*Dikgale + 0.575*BRISK + 0.152*CORIS;*

*RSA(rural) = 5.932*Lebowa + 8.019*Dikgale + 0.011*BRISK + 0.032*CORIS*

*RSA(urban) = 3.002*Lebowa + 4.059*Dikgale + 1.078*BRISK + 0.250*CORIS.*

Method 2: Adult data were calculated by using proportions of urban and rural data for black and non-black ethnic groups according to the Census '1996 results (Central Statistical Services 1999). BRISK represented urban blacks, and the average of Lebowa and Dikgale represented rural blacks, CORIS-urban represented non-black urban and CORIS-rural represented non-black rural. In terms of the original databases, after adjusting for sample size, the following equations were obtained:

*RSA = 0.642*CORIS urban + 0.152*CORIS rural + 0.948*BRISK + 2.628*Lebowa + 3.553*Dikgale;*

*RSA(rural) = 0.110*CORIS(rural) + 1.874*Lebowa + 2.534*Dikgale;*

*RSA(urban) = 0.800*CORIS(urban) + 1.181*BRISK.*

Method 1 results corresponded with results from the NFCS, which was over-sampled for lower socio-economic areas, whereas the results from method 2 ignored relationships with NFCS data and was based on the ethnic proportions of the population in South Africa.

Results: Food items consumed by at least 3% of one age group (for the 3 age groups) (adults = method 1) were: maize porridge, maize-based snacks, maize-based breakfast cereals such as corn flakes, samp, oats, white rice, maltabella

porridge (sorghum), cookie/cake, fat cakes, wheat breakfast cereal, white bread, brown bread, canned fish, fried fish, orange juice, apples, bananas, breast milk, beef steak, beef stew, minced meat dish, beef sausage (wors), beef gravy, chicken meat, chicken stew, chicken giblets, chicken heads and feet, mutton, full cream milk, full cream milk (reconstituted), full cream processed milk, high fat cheese, buttermilk, white cooking fat, chicken eggs, peanut butter, dried beans, carrots, potatoes, soup, coffee, tea, white sugar, jam, boiled sweets, carbonated cold drinks, orange squash, cabbage, pumpkin, fresh tomato, tomato and onion stew, wild green leaves/spinach, pickled vegetables (atchar), non-dairy creamer, brick margarine, medium fat spread, sunflower oil and tap water.

Additional items, which were consumed by at least 3% of the older group when using method 2, are included. These are items appearing over and above the existing food items: beer, spirit drinks, custard/maizena, rusks, grapes, peaches, beef gravy (flour type), beef offal, skim milk, sweet potatoes, fried onions, green beans and peas. The tables generated in the text present data on percentage children and adults consuming the food items, average potion size of consumers, and per capita portion size of the whole group. It is recommended that average portion size of consumers, and not per capita portion size, be used by the Department of Health to compile their shopping list. The reason for this being the fact that per capita portion size would greatly under-estimate contaminants determined.

Mean weights and standard deviations calculated for the different age groups, were for 1-5 years: 14.2 (3.5) kg; 6-9 years: 22.5 (4.8) ; adults method 1: 55.7 (19.5) and method 2: 60.9 (19.7).

A final table is included which provides the 97.5th percentile of the consumption figures (consumers only), as well as the corresponding gram per kilogram body weight consumed. These figures represent the most popular food items consumed as described above, for the following age groups: 1-5 years, 6-9 years and age 10+ (adults).

2. INTRODUCTION

National departments of health have a responsibility to ensure that (a) toxic chemicals such as pesticides, heavy metals and environmental contaminants; (b) naturally occurring toxins; and (c) food additives are not present in food and drinking water at levels that may adversely affect the health of consumers. For this purpose Acceptable Daily Intakes (ADIs) of different contaminants have been determined and need to be adhered to (WHO 1985). Dietary intake studies provide detailed data on the types and amounts of foods consumed by the majority of the population, including vulnerable groups. These intake studies, which indicate average intakes and the most commonly consumed foods, should be used to ensure that exposure to toxic residues are within acceptable limits. A table, determined from such studies, will serve as a reference list for the analysis of specific contaminants.

The World Health Organisation (WHO), the Food and Agriculture Organisation (FAO) and the United Nations Environment Programme (UNEP) have jointly developed guidelines for the determination of chemical contaminants in foods and

beverages (WHO 1985; WHO 1997b; WHO 1998). These guidelines provide detailed procedures and methods by which such studies should be conducted. The objectives are to ascertain whether consumers are at risk of chemical contaminants found in the foods, which they consume. Since South Africa is a member of the Codex Alimentarius Member Countries, it is required to undertake an analysis of contaminants in the national food supply on a regular basis.

Three practical approaches to determine measurements of contaminants in dietary intake studies have been recommended. (a) the total diet study (TDS) method; (b) selective studies of individual foodstuffs; and (c) duplicate portion studies. Since the WHO/FAO have recommended the use of the "total diet study" approach, focusing on consumption of the general population, this method has been selected for the current study. The TDS protocol describes the selection of food groups/items, which represent 95% or more of the items consumed by the population (WHO 1997a; WHO 1997b, WHO 1999). In this study, all possible items were listed, as well as items consumed by 3% or more of the study group.

Tables were generated based upon results of the TDS. The Directorate: Food Control will subsequently undertake the analyses of the foods presented in these tables. Foods will be purchased at the market and individual food items will be combined to form composites before analyses of the selected contaminants. Contaminant exposure doses will be calculated for the population by multiplying average food intake by substance concentrations to determine average daily dose per contaminant. Evaluation of risk will be determined by comparison of exposure doses with exposure limits according to the Acceptable Daily Intakes (ADIs), Theoretical Maximum Daily Intakes (TMDIs) and Codex Maximum Residue Limits (MRLs)(WHO 1997a; WHO 1997b, WHO 1999).

It is recommended that each individual country should estimate its own food consumption patterns (WHO 1998). Where no local food consumption data are available it is possible to predict food intakes based on food balance sheets compiled by the FAO or by that specific country. These are generally based on a country's annual food production, imports and exports. However, waste at the household level is not taken into consideration. Consequently food balance sheets over-estimate intakes by about 15% (WHO 1998). Ideally food and beverage intakes should be based on average consumption data of actual dietary surveys, which are based on sound and internationally recognized dietary methods.

3. OBJECTIVES OF THE STUDY

The primary objective of the present study was to generate a reference table indicating the most commonly consumed food items comprising average daily consumption of foods in the diet of South Africans. The food items commonly consumed were based on existing data from previous dietary surveys conducted in South Africa since 1983. The table was required to be representative of foods eaten by children and adults of all age groups and from all major ethnic groups in the nine different provinces.

The Directorate: Food Control of the Department of Health will use the tables to create a shopping list that will be used to purchase foods, prepare dishes

according to specific recipes and finally, to analyse all the foods (including beverages/water) for selected contaminants. The analysis is in accordance with the comprehensive list specified by the WHO (1999) in Appendix A, namely: DDT complex; endosulfan; endosulfan sulfate; endrin; total hexachlorocyclohexane isomers; the sum of aldrin and dieldrin; the sum of heptachlor and heptachlor epoxide; hexeachlorobenzene; polychlorinated biphenyls; dioxins; lead; cadmium; mercury; aflotoxins; ochratoxin A; patulin; fumonisins; diazinon, fenitrothion; malathion; parathion; methyl parathion; methyl pirimiphos; chlorpyrifos; dithiocarbamates; radionuclides; nitrates and nitrites. As necessary, this list can be elaborated on. The analyses will be undertaken in accordance with standard operating procedures, by the Department of Health.

A secondary objective of the study was to derive average (mean) weights of subjects examined in the different dietary studies in order for the Department of Health to calculate the dietary exposure of the selected contaminants (WHO 1997a), where:

*Dietary Exposure=(Food Chemical Concentration*Consumption)/(Body Weight).*

4. METHODOLOGY

4.1 Introduction

The objective of the current study was to generate tables of commonly consumed food items, which would represent the average daily consumption of South Africans. This was done by means of secondary data-analysis of existing dietary databases (raw data) from studies conducted between 1983 and 2000. The methods used to generate the tables for this report describe the manner in which the databases were formatted and combined in order to obtain the most reliable results. Most databases were available on Excel spreadsheets and were subsequently analysed using the SAS System for Windows, Release 8.02 (SAS 2001).

4.2 Dietary survey databases utilised in the development of the food tables

A brief summary of each dietary study is described in this section and shown in Table 1. The articles cited include detailed dietary methodologies for each study used in this report. Two types of dietary methods have been used in these studies and will be briefly described:

- The 24-hour recall method requires participants to recall all food and beverages consumed during the previous 24 hours. It is a reflection of current dietary consumption. A limitation of this method is that it is inclined to under-report dietary intake.
- The quantified food frequency method requires participants to recall average amounts of food consumed on a daily, weekly or monthly basis. It is a reflection of a longer period of consumption. A limitation of this method is that it is known to over-report dietary intakes (Nelson & Bingham 1997).

4.2.1 National Food Consumption Survey - Project leader: Prof D Labadarios (Labadarios et al. 2000).

The National Food Consumption Survey (NFCS), carried out in 1999 (n= 2868), was based on a random representative sample of children aged 1 – 9 years old, from all ethnic groups and provinces in South Africa, with over-sampling of children living in low socio-economic areas. The following information gathered in the survey were used in the present study: 24-hour recall data, quantitative food frequency data and anthropometrical data.

4.2.2 The Lebowa Study - Project leader: Dr NP Steyn (Steyn et al. 1992; Steyn et al. 1993a; Steyn et al. 1993b; Badenhorst et al. 1993).

The Lebowa Study was undertaken in rural villages of the Northern Province in 1991. Anthropometric and dietary data (24-hour recalls) were collected for black preschool children (n=118) and school children aged 6-25 years (n=365). The study examined the nutritional status of children in rural areas of the Northern Province, in order to determine the extent of undernutrition and quantity and quality of the diet consumed.

4.2.3 The Dikgale Study - Project leader: Dr NP Steyn (Steyn et al. 1998a; Steyn et al. 2001b; Steyn et al. 2001c).

The Dikgale Study (1998) examined the dietary intake and weight status of black adults in rural villages of central Northern Province. Average dietary intakes were calculated for 210 (anthropometry for only 111 adults available) adults. The repeated 24-hour recall method was used to determine dietary intakes.

4.2.4 The Black Risk Factor Study – Project leader: Dr K Steyn (Bourne et al. 1993; Bourne et al. 1994a; Bourne et al. 1994b).

The Black Risk Factor Study (BRISK) (1983–1990) examined risk factors for cardiovascular disease in urban black Africans living in Cape Town including: smoking, dietary factors, weight status, alcohol consumption and physical activity. This database included dietary intake data on 3 – 60+ year-olds (n= 1507), based on the 24-hour recall method.

4.2.5 The Transition, Health and Urbanisation Study - Project leader: Prof. HH Vorster (MacIntyre et al. 2000a; MacIntyre et al. 2000b; MacIntyre et al. 2000c; MacIntyre et al. 2002; Venter et al. 2000; Vorster et al. 2000).

The Transition, Health and Urbanisation in South Africa (THUSA) Study (1996-1998) examined the effect of urbanisation on the health status and dietary intakes of the black population (urban and rural) of the North West Province of South Africa (n = 1854 adults). For the purpose of this study, a sample of 890 participants, referred to by MacIntyre et al. (2000b), was used. Data on food consumption were obtained by means of a quantified food frequency method.

4.2.6 The Transition, Health and Urbanisation Bana Study - Project leaders: Dr HS Kruger & Prof. JH de Ridder (Underhay et al. 2001; Kruger et al. 2002).

The THUSA Bana study (2000 – 2001) examined the prevalence of obesity and associated factors among 10-15 year-old children (n=1257) in the (rural and urban) North West Province, South Africa. Data on food consumption was obtained by means of a 24-hour recall.

4.2.7 First Year Female Students Project - Project leaders: Dr NP Steyn & Dr M Senekal (Steyn et al. 2000a; Steyn et al. 2000b; Senekal et al. 2001).

The First Year Female Students (FYFS) Project was undertaken in 1994 at the University of the North. First-year entering black female students aged 18-34 years (n=431) comprised the sample. Anthropometric and dietary data (n=136) were collected from each student by means of a quantified food frequency questionnaire. Sixty percent of the students came from rural areas and 40 % from urban areas, mainly Gauteng.

4.2.8 Weight and Risk Factor Study - Project leaders: DR M Senekal & Dr NP Steyn (Senekal & Steyn 1997; Senekal et al. 2002).

In the Weight and Risk Factor Study (WRFS) dietary data was obtained by means of a semi-quantitative food frequency questionnaire. Self-reported height and weight measurements were also collected for black, white, Asian and "coloured" adults aged 18 – 55 years (n=449) from all provinces of South Africa by means of a postal survey.

4.2.9 Coronary Risk Factor Study - Project leader: Dr J Rossouw, Dr P Jooste & Dr K Steyn (Steyn et al. 1989; 1997; Wolmarans et al. 1989; Wolmarans et al. unpublished).

The baseline Coronary Risk Factor Study (CORIS) was undertaken in 1979 to establish prevalence and intensity of coronary risk factors in white adult populations in 3 towns in the Western Cape. Anthropometric measurements and dietary intakes (24-hour recall) were measured in participants aged 15 to 64 years (n=1784) and again in 1983 (unpublished).

4.2.10 Food balance sheets for South Africa - 1998/99 (Steyn et al. 1998b; Steyn et al. 2001a).

Food balance sheets (1998) were obtained from the Department of Agricultural Statistics. They comprise per capita consumption data that were derived by taking the total production of a specific food item in the country, and by subtracting the total amount used for animal feed and the total amount exported, and then by adding the total amount imported. This amount was then divided by the total population, giving per capita availability of each food item. All per capita food items were calculated in terms of the average energy, protein, carbohydrate and fat available on a per capita basis.

4.2.11 A liquid consumption survey of individuals in Greater Cape Town – Project leader: Dr LT Bourne (Bourne 1986).

Water intakes were added to the final tables generated based on the results of the study undertaken by Bourne in Cape Town (1986) and from the BRISK study (Bourne et al. 1993).

4.2.12 Summary

Table 1 provides a summary of the databases used in this study indicating: age group, ethnic group, area of residence (urban/rural), and year of publication. The definitions of the NFCS were used to define urban and rural, namely:

- Urban describes areas within municipal or local authority boundaries. These include formal and informal areas in towns and cities.
- Rural describes areas not sharing common boundary with a proclaimed urban municipal area. This includes "tribal" areas and commercial farms.

Table 1: Summary of databases used in the present study

Database & dietary method used	Ethnic group	Area	Groups	Age in years: (total n) Age in years: (subgroup n)	Publications
NFCS 24HR FFREQ	All	South Africa	Preschool & primary	1-9: n=2868 1-5: n=2051 6-9: n=817	Labadarios et al. (2000)
Lebowa Study 24HR	Black	Northern Province, rural	Preschool, primary school, secondary school)	1 – 25: n=483 1- 5: n=118 6-9: n=73 10+: n=292 10-13: n=187 14-18: n=75 19-25: n=30	Steyn et al. (1992) Steyn et al. (1993a) Steyn et al. (1993b) Badenhorst et al. (1993)
Dikgale Study 24HR	Black	Northern Province, rural	Adults (19 year and above)	(n=111 with age available) (209 in total) 19-24: n=2 25-39: n=33 40-59: n=38 60+: n=38	Steyn et al. (1998a) Steyn et al. (2001b) Steyn et al. (2001c)
BRISK 24HR FFREQ	Black	Western Cape, urban	Children & Adults	3 – 99: n=1507 1-5: n=127 6-9: n=137 10+: n=1243 10-13: n=133 14-18: n=146 19-24: n=199 25-39: n=372 40-59: n=245 60+: n=148)	Bourne et al. (1993) Bourne et al. (1994a) Bourne et al. (1994b)

Table 1 (continued)					
Database & dietary method used	**Ethnic group**	**Area**	**Groups**	**Age in years: (total n)** **Age in years: (subgroup n)**	**Publications**
THUSA FFREQ	Black	North West Province, urban & rural	Adults	18+ : n=890 14-18: n=81 19-24: n=137 25-39: n=318 40-59: n=302 60+ : n=52	Venter et al. (2000) Vorster et al. (2000) MacIntyre et al. (2000a) MacIntyre et al. (2000b) MacIntyre et al. (2000c) MacIntyre et al. (2002)
THUSA Bana 24HR	All	North West Province, urban & rural	Children	All: n=1257 6-9: n=6 10-13: n=868 14-18: n=383	Underhay et al. (2001) Kruger et al. (2002)
FYFS FFREQ	Black	Northern Province, Gauteng, urban and rural	Adult females	18-34: n=136 <18 : n=52 19-24: n=63 >=25: n=21	Steyn et al. (2000a) Steyn et al. (2000b) Senekal et al. (2001)
WRFS FFREQ	All	South Africa	Adults	18+ : n=449 1: <25: n=43 2:25-34:n=124 3:35-44:n=117 4:45-54:n=93 5:55-64:n=61 6:65+: n=9	Senekal & Steyn (1997) Senekal et al. (2002)
CORIS 24HR	White	Western Cape, urban & rural	Adults (15 year and above)	15- 99: n=1784 14-18: n=281 19-24: n=127 25-39: n=463 40-59 n=686 60+ : n=227	Wolmarans et al. (1989) Steyn et al. (1989) Steyn et al. (1997) Wolmarans (unpublished data)
SA Food Balance Sheets	All	South Africa	All	All	Steyn et al. (2001) Department of Agricultural Statistics
Water estimates	White & coloured	Greater Cape Town			Bourne (1986) Bourne et al. (1993)

4.3 Structuring of the existing dietary databases

Step 1: Standardisation of food codes in all dietary databases.
The dietary databases used in this study made use of the MRC Food Composition Tables (Langenhoven et al. 1991). These tables were updated in 1999 and many of the food codes were changed (MRC 1999). Hence it was necessary to first ensure that all the databases conformed to the updated food codes.

Step 2: Aggregation of information on food.
The WHO (1999) provides three lists of analyses and commodities that should be monitored by member countries of the Codex Allimentarius: a core list (for developing countries), an intermediate list (for countries with some industrial development) and a comprehensive list (for developed countries) (Appendix A). Because of the availability of the NFCS data (Labadarios et al. 2000), and other appropriate surveys, this study focused on providing tables, which would be sufficiently detailed for analysis of contaminants according to the comprehensive list, if required. In order to compile comprehensive tables, aggregation of food items was done at three levels:

Level 1: Foods and beverages contained in the South African food composition tables were first classified into food categories according to the GEMS/Food commodities (WHO 1998) (Table 2). The GEMS/Food categories include the following main groups: cereals; sugars and honey; nuts and oilseeds; vegetable oils and fats; stimulants; spices; pulses; roots and tubers; vegetables; fish and seafood; eggs; fruit; milk and milk products; meat and offal; animal oils and fats. Since there were no GEMS/Food codes for some food commodities, new groups were created for: alcoholic beverages, infant foods, breast milk and breast milk substitutes, dietary supplements and soup mixes. This was done since these groups represent important commodities in the South African total diet.

Level 2: Certain main groups were further sub-divided into smaller groups (Table 2). For example, cereals were sub-divided into maize, wheat, oats, barley, sorghum, rye and rice products. Fruit, vegetables, meat and offal were also further sub-divided.

Table 2: Grouping of foods into groups and subgroups according to GEMS/Food commodities[a]

GEMS/Food Main Group	GEMS/Food Subgroup	GEMS/Food Codes	Description
Alcoholic beverages	Alcoholic beverages	ALC XX1# ALC XX2# ALC XX3# ALC XX4# ALC XX5# ALC XX6# ALC XX7# ALC XX8# ALC XX10#	Beer – commercial type Sorghum beer Stout beer Cider Liqueur Sherry Spirit- brandy, gin, vodka, whiskey Wines Flavoured alcoholic grape drinks
Cereals	Barley	GC 640	Barley
	Millet	GC 646	Millet
	Maize	CF 1255 GC 645 GC 656	Maize flour & products Maize samp/rice & dishes Popcorn
	Oats	GC 647	Oats & muesli
	Rice	CM 1205 GC 649	Rice flour & products Rice (white / brown)
	Sorghum	GC 651	Sorghum

Table 2 (continued)			
GEMS/Food Main Group	**GEMS/Food Subgroup**	**GEMS/Food Codes**	**Description**
Cereals (continued)	Wheat	CP 1211	White bread / rolls
		CP 1212	Brown bread /rolls
		CF 1211	Wheat flour & products
		CF 1210	Wheat germ & products
		GC 653	Crushed wheat/wheat pearl
		CF 1212	Pasta
	Rye	CF 1250	Rye bread
Condiments	Condiments	CON XX1#	Chutney, chakalaka, atchar
		CON XX3#	Worcester sauce
		CON XX4#	Sweet & sour sauce
		CON XX5#	Curry / mustard sauce
		CON XX6#	M-gland/pepper/BBQ/garlic sauce
		CON XX7#	Salt
		CON XX8#	Aromat /garlic salt / seasoning
		CON XX10#	Gelatin
		CON XX11#	Vinegar
		CON XX12#	Marmite
		CON XX13#	Baking powder
		CON XX14#	Sandwich spread
		CON XX15#	Sweetener
		CON XX16#	Yeast
Fish and seafood	Crustaceans	WC 143	Crustaceans
	Fish	MD 180	Dried fish (“bokkems”)
		WF 115	Fresh water fish
		WS 125	Fish & fish products (from the sea)
		WS XX1#	Cod liver oil
		WS XX2#	Caviar
Fruit	Berry fruit	FB 18	Mulberries
		FB 20	Blueberres
		FB 266	Youngberries
		FB 268	Gooseberries
		FB 269	Grapes
		FB 272	Raspberries
		FB 275	Strawberries
		FB XX1#	Fruit mince
	Citrus fruit	FC 2	Lemons / limes
		FC 203	Grapefruit
		FC 3	Naartjies
		FC 4	Oranges
		FC XXX#	Fruit Punch (citrus base)
	Fruit – figs, dates, etc.	FT 292	Custard apples
		FT 295	Dates
		FT 297	Figs
		FT 307	Persimmons
		FT XX1#	Prickly pears
	Pome fruit	FP 226	Apples
		FP 230	Pears
		FP 231	Quinces
		FP 9	Loquats, litchis, guavas, wild fruits

Table 2 (continued)			
GEMS/Food Main Group	**GEMS/Food Subgroup**	**GEMS/Food Codes**	**Description**
	Stone fruit	FS 12	Sou sous
		FS 13	Cherries
		FS 14	Plums / prunes
		FS 240	Apricots
		FS 245	Nectarines
		FS 247	Peaches
		FS XXX#	Fruit cocktail/ salad, (peach-base)
	Tropical fruit	FI 326	Avocados
		FI 327	Bananas
		FI 341	Kiwis
		FI 345	Mangoes
		FI 350	Paw paws
		FI 351	Granadillas
		FI 353	Pineapple
		FI XX2#	Fruit salad (tropical fruit)
Breast milk & breast milk substitutes	Breast milk & breast milk substitutes	BMS XX1#	Acidified formula
		BMS XX2#	Casein-predominant
		BMS XX3#	Follow-up, weaning
		BMS XX4#	Lactose-free
		BMS XX5#	Premature, whey-predominant
		BMS XX6#	Semi-elemental
		BMS XX7#	Soy-based
		BMS XX8#	Whey-predominant
		BMS XX9#	Human milk
Infant foods	Infant foods	INF XX1#	Baby cereal
		INF XX2#	First food jar – vegetable
		INF XX3#	Infant dinner – fruit & vegetables
		INF XX4#	Junior foods
		INF XX5#	Strained foods
Meat & offal	Insects	INS XX1#	Mopanie worms
	Beef	MM 812	Beef & beef products
	Poultry	PM 840	Chicken meat
		PM 841	Duck
		PM 842	Goose
		PM 848	Turkey
		PM 8X1#	Ostrich
		PM 8XX1	Pheasant / guinea fowl
	Goat	MM 814	Goat
	Pig	MM 818	Pork
	Sheep	MM 822	Mutton
	Venison	MM XX1	Venison
	Beef offal	MO 1280	Beef kidney
		MO 1281	Beef liver
		MO 812	Beef offal, other
	Chicken offal	PO 111	Chicken heads, feet, giblets
		PO 113	Chicken skin
		PO 840	Chicken liver
	Pork offal	MO 818	Pork trotters
	Sheep offal	MO 822	Sheep offal
Milk & milk products		ML 812	Cow's milk& products
		ML 814	Goat's milk & products
		ML 822	Sheep's milk & products
		ML XX1#	Butro (mixture of margarine & butter)
		ML XX2#	Butter
		ML XX3#	Cream

Table 2 (continued)			
GEMS/Food Main Group	**GEMS/Food Subgroup**	**GEMS/Food Codes**	**Description**
		ML XX4#	Butter & hard margarine, mixed
Animal oils & fats	Animal oils & fat	FA 818 MF 812 MF 818 MF 822 PF 840	White cooking fat Beef tallow Lard Mutton fat Chicken fat
Eggs	Eggs	PE 840	Eggs and products
Nuts & oilseeds	Oilseeds	SO 693 SO 697 SO 700 SO 702 SO 703 SO 88 SO 90 SO XX# SO XX2#	Linseed Peanuts Sesame seed Sunflower seed Peanut butter Coriander seed Mustard seed Pumpkin seed Watermelon seed
	Olives	FT 305	Canned olives
	Tree nuts	TN 295 TN 660 TN 664 TN 665 TN 666 TN 672 TN 675 TN 678 TN 85X2# TN 85X3# TN 85X4# TN 85X5#	Cashew nuts Almonds Chestnuts Coconuts – meat, flesh & skin Hazelnuts Pecan nuts Pistachio nuts Walnuts Betel nuts, pignolia nuts Brazil nuts Macadamia nuts Mixed nuts
Soup mixes	Soup mixes	SP X1# SP X2# SP X3# SP X4# SP X5# SP XA#	Soup mix, chicken Soup mix, beef Soup mix, vegetable Soup mix, high-protein, (school feeding) Soup – snoek kop Soup mix, average
Herbs & spices	Herbs & spices	HH 740 HS 93X HS XXX	Parsley Basil, pepper, curry masala, etc. Coriander leaf
Stimulants	Cocoa	DM 715	Cocoa powder & chocolate sweets
	Coffee	SM 716	Coffee
	Ginger	HS 784	Ginger root
	Tea	DT 171 DT 171X# DT 171Y#	Ceylon tea Rooibos tea Herb tea
Sugars & honey	Sugar	GS 659X# GS 659Y#	White sugar Brown sugar
	Honey	GS 659P	Honey
	Sugar products	GS 659	Sugar products (sweets, puddings, desserts, syrups, cold drinks, icing, etc.)
Supplements	Supplements	SUPPL#	Miscellaneous dietary products ie. high-energy drinks)

Table 2 (continued)

GEMS/Food Main Group	GEMS/Food Subgroup	GEMS/Food Codes	Description
Vegetables	Brassica	VB 400	Broccoli
		VB 402	Brussels Sprouts
		VB 404	Cauliflower
		VB 405	Kohlrabi
		VB 41	Cabbage
	Bulb vegetables	VA 381	Garlic
		VA 384	Leek
		VA 385	Onion
		VA 388	Chives
	Cucurbits	VC 424	Cucumber
		VC 429	Pumpkin – butternut/hubbard
		VC 431	Pumpkin – marrow/gems -summer
		VC 432	Watermelon
		VC 46	Melon – green/orange flesh
	Fruity vegetables	VO 1275	Corn-on-the–cob, sweet corn
		VO 440	Brinjal
		VO 442	Okra
		VO 444	Peppers, chili
		VO 445	Peppers, sweet, green/red
		VO 448	Tomatoes
		VO 450	Mushrooms
		VO 450X#	Kalahari truffles
	Green Legumes	VP 526	Green beans
		VP 528	Peas-in-pod
		VP 529	Peas, green
		VP 534	Bean sprouts
	Stem vegetables	VS 620	Artichoke
		VS 621	Asparagus
		VS 624	Celery
		VS 627	Rhubarb
		VS 62X#	Bamboo shoots
	Leafy vegetables	VL 469	Chicory
		VL 473	Watercress
		VL 476	Endive
		VL 480	Kale
		VL 482	Lettuce
		VL 502	Spinach
		VL 53	Wild leaves (marog, amaranthus, beetroot, pumpkin)
	Mixed vegetables	VG XXZ#	Mixed vegetables
Pulses	Dry legumes	VD 523	Broad beans, dried
		VD 524	Chick peas, dried
		VD 533	Lentils
		VD 541	Soy beans, dried
		VD 71	Sugar/kidney/haricot beans, dried
		VD 72	Split peas
Roots & Tubers	Roots & tubers	VR 494	Radishes
		VR 505	Amadumbes / taro
		VR 506	Turnips
		VR 508	Sweet potatoes
		VR 574	Beetroot
		VR 577	Carrots
		VR 588	Parsnips
		VR 589	Potatoes

Table 2 (continued)			
GEMS/Food Main Group	**GEMS/Food Subgroup**	**GEMS/Food Codes**	**Description**
Vegetable fats & oils	Vegetable oil	OC 305	Olive oil
		OC 645	Maize oil
		OC 691	Cotton seed oil
		OC 696	Palm kernel oil
	Vegetable oil and products	OR 172	Vegetable oil (50% sunflower oil) & products (non-dairy creamer, sorbet ice cream, margarine, salad dressing)
		OR 495	Canola oil
		OR 541	Soy bean oil
		OR 665	Coconut oil
		OR 693	Safflower oil
		OR 697	Peanut oil
		OR 702	Sunflower oil
Water	Water	WATER#	

[a] World Health Organisation (1998)
New GEMS/Food codes

Level 3: This step involved grouping items of consumption within the GEMS/Food subgroups. This involved aggregating (grouping) foods that were similar in kind but are consumed in smaller amounts. Re-coding all food items into the EURO Codes made this possible since the EURO Codes provided more detail within food subgroups (Eurocode 2001)(Table 3).

Level 4: Lastly, food items were also classified according to method of processing. Due to the relative importance of processing methods in determining levels of contaminants, foods and beverages were further categorized according to processing methods (WHO 1997b). Processing methods and some examples of applications used by the industry are:

CF = Cooked fresh
CZ = Frozen, cooked
CA = Canned
SM = Smoked
RF = Raw fresh
DR = Dried (combined raw & cooked)
JU = Juice
SN = Snack
FL = Milled
PI = Pickled

When a "P", immediately follows the GEMS/Food code, this indicates that a "product" is formed, namely some form of processing has taken place. The preceding steps were taken to develop a new database comprising 1535 food items, originally created in the Food Composition Tables (Langenhoven et al. 1991; MRC 1999). Each food item now comprised a national (SA) food composition code and description; a GEMS/Food main group code (WHO 1998); a GEMS/Food subgroup code (WHO 1998); a detailed item code (Eurocodes 2001) and a description of processing when appropriate.

Examples are of food groups are presented in Table 3. The complete list of food items is provided as Appendix B.

Table 3: Example of the final food item database with its various aggregates

GEMS/ Food Main Group	GEMS/Food Subgroup	Combination of codes	Description of food items
Alcoholic beverages	None	As in Table 2	
Cereals	Combined Gems codes with Euro codes. The purpose was to distinguish between milled and grain products, breakfast cereals, snacks, breads and confectionary.		
	MAIZE	CF 1255 06.18	MAIZE PORRIDGE & DISHES
		CF 1255 06.19	CUSTARD POWDER, CORN STARCH
		CF 1255 06.70	BREAKFAST CEREALS, MAIZE BASED, CORN FLAKES, ETC.
		CF 1255 11.10	MAGEU – MAIZE DRINK
		CF 1255 12.65	MAIZE BASED SNACKS - NIKNAKS, CHIPNIKS
		GC 645 06.18	MAIZE SAMP/RICE & DISHES
		GC 656 12.65	POPCORN
	WHEAT	CF 1210 06.10	TASTEE WHEAT, WHEAT GERM, SEMOLINA
		CF 1211 06.10	WHEAT FLOURS
		CF 1211 06.40	ROTI
		CF 1211 06.44	MATZOS, CRACKERS, PRO VITA
		CF 1211 06.48	RUSKS
		CF 1211 06.50	COOKIES, LOAVES, PANCAKES, TARTS, CAKES, PUDDING
		CF 1211 06.60	SAMOOSA, VETKOEK, CHILI BITES, SAVOURY TARTS
		CF 1211 06.70	WHEAT BASED CEREALS - ALL BRAN, WEETBIX, PUFFED WHEAT
		CF 1212 06.30	PASTA & NOODLE DISHES
		CP 1211P	WHITE BREAD / ROLLS
		CP 1212P	BROWN BREAD / ROLLS
		GC 654P 06.10	CRUSHED & PEARL WHEAT
Condiments	None	As in Table 2	
Fish	Combined GEMS/Food code with processing method. Overall consumption of fish was too little to distinguish food items in more detail		
	CRUST	WC 143 CF	CRUSTACEANS (CRAB, LOBSTER, MUSSEL, OYSTER), COOKED
	FISH	WF 115 CF	FISH, FRESH WATER, COOKED
		WS 125 CF	FISH - SEA, COOKED, FRESH
		WS 125 CZ	FISH - SEA, FROZEN, COOKED
		WS 125P CA	FISH - SEA, CANNED
		WS 125P CF	FISH PASTE
		WS 125P SM	FISH - SEA, SMOKED
Fruit	Combined GEMS/Food code with processing method. Overall consumption of individual fruit was too little to provide more detail. Note that fresh juice was not considered as a "product", but commercially canned/bottled juice was.		
	BERRY FRUIT	FB 269 RF	GRAPE, RAW FRESH
		FB 269P CA	GRAPE, SULTANAS, CANNED IN SYRUP

Table 3 (continued)			
GEMS/ Food Main Group	**GEMS/Food Subgroup**	**Combination of codes**	**Description of food items**
Fruit		FB 269P DR	RAISINS, CURRANTS, DRIED
		FB 269P JU	GRAPE JUICE (LIQUIFRT/CERES, BOTTLED)
	CITRUS FRUIT	FC 3 RF	NAARTJIE, RAW, (PEELED)
		FC 3P JU	NAARTJIE JUICE (CERES/CANNED)
		FC 4 RF	ORANGE/MINEOLA FRESH (PEELED)
		FC 4P JU	ORANGE JUICE (LIQUI FRT/CERES, CANNED/BOTTLED)
	For more detail on food groups, see Table 2 and Appendix B		
HM&BMS	None	As in Table 2	
Infant foods	None	As in Table 2	
Meats and offal	It was important to distinguish between the different kinds of animals and the different parts of the carcass eaten, especially in the case of offal. Favourite South African dishes are also reflected.		
	INSECTS	IS	MOPANIE WORMS
	BEEF	MM 812 03.10 CF	BEEF (STEAKS, FILLET, SIRLOIN, ETC)
		MM 812 03.60CF	BEEF MINCE
		MM 812P 03.10CF	BEEF STEW
		MM 812P 03.50CA	PRESERVED MEATS - CORNED MEAT, CANNED
		MM 812P 03.51DR	PRESERVED MEATS - BILTONG, DRY SAUSAGE
		MM 812P 03.60CF	MEAT PRODUCTS & DISHES - BOBOTIE, COTTAGE PIE,PIES,BALLS -COOKED FRESH
		MM 812P 03.60CZ	MEAT PRODUCTS & DISHES - BOBOTIE, COTTAGE PIE,PIES,BALLS - FROZEN COOKED
		MM 812P 03.61CF	BEEF SAUSAGE - WORS
		MM 812P 12.18CF	BEEF GRAVY AND EXTRACTS, COOKED FRESH
		MM 812P 12.18FL	BEEF GRAVY AND EXTRACTS - FLOUR TYPE
	POULTRY	PM 840 03.30CF	CHICKEN MEAT
		PM 840P 03.30CF	CHICKEN STEWS, DISHES, PIES
		PM 841 03.39CF	DUCK MEAT
	For more detail on food groups, see Table 2 and Appendix B		
Milk	No subgroups	GEMS/Food codes were combined with MRC Food Composition Table (reference) codes, indicated in brackets, to distinguish between full cream, low fat and skim milk products. This was then combined with the EURO codes to distinguish between milk, yoghurt, cheese, ice cream, condensed milk, evaporated milk, milk products and dishes.	
		ML 812 (1) 01.10	FULL CREAM LIQUID MILKS
		ML 812 (10) 01.10	SKIM MILK PRODUCTS AND DISHES (MELKKOS, MILK SHAKE, OVALTINE, INSTANT P

Table 3 (continued)			
GEMS/ Food Main Group	**GEMS/Food Subgroup**	**Combination of codes**	**Description of food items**
		ML 812 (10) 01.15	PROCESSED SKIM MILK (POWDER, RECONSTITUTED)
		ML 812 (10) 06.65	SKIM MILK SWEET PUDDINGS, (EGGNOG, MILK JELLY, BLANCMANGE)
		ML 812 (12) 01.15	MILK BLENDS (DAIRY FRUIT JUICE MIX)
		ML 812 (12) 01.60	BLENDED MILK, PROCESSED (POWDER, RECONSTIT)
		ML 812 (2) 01.10	FULL CREAM MILK PRODUCTS AND DISHES (MELKKOS, MILK SHAKE, OVALTINE, INS
		ML 812 (2) 01.15	FULL CREAM PROCESSED MILK, (POWDERS, RECONSTITUTED)
		ML 812 (2) 01.16	FULL CREAM PROCESSED MILK, (EVAPORATED)
		ML 812 (2) 01.17	FULL CREAM PROCESSED MILK, (CONDENSED MILK)
		ML 812 (2) 01.18	FULL CREAM PROCESSED MILK, (BUTTERMILK, MAAS)
		Full lists will be provided in Appendix B	
Animal fat	No subgroups	As in Table 2	
Eggs	No subgroups	As in Table 2	
Nuts and oil seeds	Subgroups are tree nuts, olives and oilseeds	As in Table 2	
Soups	No subgroups	As in Table 2	
Herbs and spices	No sub groups	As in Table 2	
Stimulants	Subgroups are coffee, tea, cocoa and ginger	As in Table 2	
Sugar and sugar products	GEMS/Food codes were combined with the EURO codes to distinguish between different dishes which had all been grouped together under the GEMS/Food codes, such as sugar, honey and cold drinks.		
	Refined sugar	GS 659X 10.10	SUGAR, WHITE
		GS 659Y 10.10	SUGAR, BROWN
	Honey	GS 659P 10.20	HONEY
	Other sugar products	GS 659P 01.65	NESQUICK/OVALTINE POWDER
		GS 659P 10.25	MOLASSE, GOLDEN SYRUP, GLUCOSE
		GS 659P 10.30	JAM /MARMELADE
		GS 659P 10.60	SWEETS, HARD BOILED, SOFT JELLY
		GS 659P 10.61	CHEWING GUM
		GS 659P 11.40	COLD DRINK, CARBONATED, AVERAGE
		GS 659P 11.48	COLD DRINK, SQUASH TYPE
Supplements	No subgroups	As in Table 2	
Vegetables	Combined GEMS/Food code with processing method.		

Table 3 (continued)			
GEMS/ Food Main Group	**GEMS/Food Subgroup**	**Combination of codes**	**Description of food items**
	Brassica	VB 400 CF	BROCCOLI, BOILED
		VB 404 CF	CAULIFLOWER, BOILED
		VB 41 CF	CABBAGE, COOKED
		VB 41 RF	CABBAGE, RAW
	Bulb vegetables	VA 385 CF	ONION, COOKED
		VA 385 RF	ONION RAW
		Full lists given in Appendix B	
Vegetable fats and oils	GEMS/Food codes were combined with EURO codes to show more detail. Important products identified in this category were non-dairy creamers, margarine and salad dressing.		
	Crude oils	OC 305	OLIVE OIL
	Refined oils	OR 172 05.70	VEGETABLE OIL (50% SUNFLOWER, 30% M
		OR 172P 01.60	NON DAIRY CREAMER, ND CONDENSED MILK, ORLEY WHIP
		OR 172P 01.70	SORBET ICE CREAM
		OR 172P 05.20	BRICK MARGARINE
		OR 172P 05.30	MEDIUM /LOW FAT SPREAD
		OR 172P 12.34	SALAD DRESSING / MAYONNAISE
		OR 702 05.60	SUNFLOWER OIL

Note that in the discussion that follows, reference will be made to the following: GEMS/Food main groups (column 1 of Table 3), GEMS/Food subgroups (column 2 of Table 3) and food items (columns 3& 4 of Table 3).

4.4 Preparation of databases for the generation of tables comprising commonly consumed food items

4.4.1 Introduction

All the databases were analysed using the SAS System for Windows, Release 8.02 (SAS 2001) and the resulting tables were formatted in a standardized manner comprising: the percentage of the population consuming the food items; the portion of the food item consumed per day of those who actually consumed it and the average portion size (per capita) for the relevant sample.

4.4.2 Selection of age groups

The WHO (1999:17) have recommended that: "…where specific national or regional consumption data are available for different population subgroups (e.g., vegetarians, toddlers and infants), exposure assessments should be carried out for these groups". Using these recommendations as guidelines, all tables generated in the present study included the age groups: Infants - age 1-5 years (1.00 – 5.99 years); young children - age 6-9 years (6.00 – 9.99 years); teenagers and adults - 10+ (sometimes referred to as "adults").

The reason for selecting these age groups is based on the fact that the largest dietary database (NFCS) in South Africa (Labadarios et al. 2000: 76-77) included children aged 1-9 years. Although over-sampled for children living in poor socio-economic areas, the data are a "fair" representation of the South African population and its diverse language distribution. Compared with the 1996 Census data (brackets) (Statistics South Africa 2000a) the home language of 10.6% of the households was Afrikaans (14.4%), 4% English (8.6%), 6.4% N. Sotho (7.7%), 2% Ndebele (1.5%), 1.4% Swazi (2.5%), 11.8% Tswana (8.2%), 0.9% Venda (2.2%), 19.9% Xhoza (17.9%) and 23.5% Zulu (22.9%).

The dietary intake for the groups 1-5 years and 6-9 years were used directly from the NFCS, and were not supplemented by other databases.

Vulnerable groups such as pregnant women and the elderly could not be determined since no or very little data were available on these groups.

The substantiation for treating age 10+ as a unit (and calling it an adult group) was the finding that the average consumption of adolescents (10 – 15 years) did not differ significantly from that of adults. Tables 4 and 5 present comparisons of mean energy intakes of the different age groups to substantiate this.

Table 4: Comparison of age groups in terms of quantity of food (in grams) and kilojoules consumed based on 24-hour recall studies[a]

Study	Age group	n	Total grams consumed per day (std dev) (When letters differ means are significantly different)	Total kilojoules consumed per day (std dev) (When letters differ means are significantly different)	Notes on Bonferroni / Independent t-test / Kruskal-Wallis (where appropriate) test for significant differences
NFCS	1-5	2072	1083 A (453)	4531 A (2121)	Independent t-test for both quantity and kilojoules consumed – significant difference between two age groups
	6-9	832	1224 B (480)	5722 B (2419)	
BRISK	1-5	127	1305 E (440)	5271 C (1721)	For both kilojoules and grams, 10-13 age group consumed smaller quantities than older groups, but these differences were not significant (Bonferroni)
	6-9	137	1422 E D (454)	6426 B (2180)	
	10-13	133	1662 DC (542)	7082 A B (2365)	
	14-18	146	1825 C B (604)	7993 A (3378)	
	19-24	199	1889 C B (694)	7748 A (3122)	
	25-39	372	1987 B A (832)	7541 A (3398)	
	40-59	245	2220 A (1075)	7250 A B (3444)	
	60+	148	1915 C B (823)	6289 B C (2933)	

Table 4 (continued)					
Study	**Age group**	**n**	**Total grams consumed per day (std dev) (When letters differ means are significantly different)**	**Total kilojoules consumed per day (std dev) (When letters differ means are significantly different)**	**Notes on Bonferroni / Independent t-test / Kruskal-Wallis (where appropriate) test for significant differences**
CORIS	14-18	281	2804 A (1699)	14225 A (9613)	No significant difference in quantities consumed, 14-24 years consumed significantly more kilojoules than older groups (Bonferroni)
	19-24	127	2860 A (1521)	12993 A (8397)	
	25-39	463	2703 A (1458)	11091 B (6506)	
	40-59	686	2523 A (1185)	9946 B (5592)	
	60+	227	2601 A (1532)	9749 B (4934)	
Lebowa Study	1-5	118	1151 B (336)	5211 B (1734)	Only age group 1-5 years differed significantly from other groups, when comparing average kilojoule intake and total grams consumed. The other age groups had similar means (Bonferroni)
	6-9	73	1632 A (527)	7755 A (2881)	
	10-13	187	1585 A (498)	7671 A (2813)	
	14-18	75	1617 A (547)	7707 A (2756)	
	19-24	29	1771 A (489)	7815 A (2256)	
Dikgale Study	19-24	2	1245 (65)	4561 (19)	Kruskal-Wallis test indicated no significant differences between 4 groups for quantity and kilojoules consumed
	25-39	33	1848 (762)	6702 (3732)	
	40-59	37	2079 (1408)	7270 (3823)	
	60+	37	1896 (511)	7268 (2456)	
THUSA Bana	10-13	498	1311 A (551)	11784 A (7369)	The 10-13 year-olds consumed more in terms of quantity and kilojoules, only kilojoules significant, independent t-test used.
	14-18	189	1262 A (516)	9982 B (5849)	

[a] Sources of the studies indicated in Table 1

Table 5: Comparison of age groups in terms of quantity of food (in grams) and kilojoules consumed based on food frequency studies[a]

Study	Age group	n	Total grams consumed per day (std dev) (When letters differ means are significantly different)	Total kilojoules consumed per day (std dev) (When letters differ means are significantly different)	Notes on Bonferroni / Independent t-test / Kruskal-Wallis (where appropriate) test for significant differences
THUSA	14-18	81	1861 B (599)	13588 A (5059)	Both variables increased and then decreased in older people. This increase was gradual; no group was different from the rest (Bonferroni).
	19-24	137	2007 B A (807)	14251 A (5542)	
	25-39	318	2123 B A (787)	14025 A (5995)	
	40-59	302	2207 A (923)	13569 A (6358)	
	60+	52	2092 B A (909)	13270 A (6317)	
FYFS Project	<= 18	52	2521 A (1272)	11929 A (3772)	No difference found in quantities, but an increase and then a decrease found in kilojoules. The <= 18 year-olds differed significantly from >=25 year-olds (Bonferroni).
	19-24	63	2043 A (724)	9995 A B (3381)	
	>= 25	21	2153 A (709)	9904 B (3056)	
WRFS	1: <25	43	2270 A (876)	8508 A (2972)	No significant differences found in quantities consumed, but the younger group consumed more in terms of kilojoules than middle-aged groups (Bonferroni).
	2: 25-34	124	2231 A (761)	7624 A B (2611)	
	3: 35-44	117	2296 A (844)	7388 A B (2576)	
	4: 45-54	93	2100 A (647)	6624 B (2354)	
	5: 55-64	61	2108 A (711)	6398 B (2253)	
	6: 65+	9	1997 A (749)	6963 A B (2520)	

[a] Sources of the studies indicated in Table 1

Tables 4 and 5 showed that 10 – 13 year-olds could be grouped with the adult groups since they did not differ significantly with respect to mean energy intakes. The only groups, which differed significantly with respect to mean energy intakes, were the 1-5 year-olds in the NFCS, BRISK and Lebowa studies. The 6-9 year-olds already showed some agreement with the closest older groups. Based on these findings all tables were generated according to 3 age groups: 1-5 year-olds, 6-9 year-olds and 10+ referred to as "adults".

It is important to evaluate the results of this report in the context of the databases used. The estimates generated represent crude portions of food items consumed and should not be compared with the methods generally used in dietary surveys to evaluate macro- and micro-nutrient intakes of specific age groups. Although an

attempt was made to include as many databases as possible to represent the averge South African population, it was not realistic or feasible to include every study which has been undertaken in the specified period

4.4.3 Comparison of data collected by different dietary methods

After careful consideration of the available databases, and after a comparison of data obtained by the food frequency and 24-hour recall methods of the NFCS, it was decided to keep data generated by the two methods apart. Tables 6 and 7 present the findings on such comparisons and show the following:

- average quantities consumed per food item were greater when the food frequency method was used;
- a greater variety of items were consumed when using the food frequency method versus the 24-hour recall method - 72 items versus 16 items;
- the percentage of the group consuming a specific item, was generally greater when the food frequency questionnaire was used.

Table 6: Food items consumed by 1-5 year-old children in the NFCS[a] obtained by the 24-hour recall method

	FOOD ITEM	% of group consuming the item	Average per capita g/person/day
24 HR: *List of items from most popular to least popular. *Only items eaten by at least 10% of the group have been included *Only 2 items were consumed by more than 50% of the group and 16 items were consumed by more than 10% of the group.	MAIZE PORRIDGE & DISHES	79.8	339.6
	SUGAR, WHITE	76.2	15.7
	TEA	44.4	99.7
	FULL CREAM LIQUID MILKS	38.7	71.8
	BROWN BREAD / ROLLS	35.2	31.5
	RICE WHITE/BROWN, COOKED	27.4	36.4
	WHITE BREAD /ROLLS	24.4	20.3
	BRICK MARGARINE	24.3	2.9
	POTATO, COOKED	22.3	24.0
	CHICKEN MEAT	16.6	10.1
	CABBAGE, COOKED	14.0	11.1
	FULL CREAM PROCESSED MILK, (BUTTERMILK, MAAS)	12.4	38.1
	ROOIBOS TEA	12.4	30.2
	COLD DRINK, SQUASH TYPE	12.4	34.9
	CHICKEN EGGS	11.3	7.8
	WILD LEAVES (MAROG, AMARANTH, BEETROOT, PUMPKIN)-COOKED	10.1	15.2

[a] Adapted from the National Food Consumption Survey (Labadarios et al. 2000)

Table 7: Food items consumed by 1-5 year-old children in the NFCS[a] according to the food frequency method

	FOOD ITEM	% of group consuming the item	Average per capita g/person/day
Food Frequency:	MAIZE PORRIDGE & DISHES	94.7	355.7
	SUGAR, WHITE	89.8	21.5
	POTATO, COOKED	81.7	40.2
	RICE WHITE/BROWN, COOKED	81.0	33.8
	CABBAGE, COOKED	73.8	17.4
	CHICKEN MEAT	69.4	10.4
	BANANA, RAW (PEELED)	67.3	17.3
	CHICKEN EGGS	66.0	18.5
	APPLE, AVERAGE, RAW	65.5	26.1
	TEA	62.7	122.3
	BROWN BREAD / ROLLS	61.4	36.6
	PUMKIN/BUTTERNUT, HUBBARD SQUASH, COOKED	60.7	13.9
	FULL CREAM LIQUID MILKS	57.1	81.5
	WHITE BREAD /ROLLS	56.7	29.9
***List of items from most popular to least popular. *Only items eaten by at least 10% of the group have been included. *Note that 18 items were consumed by more than 50% of the group and 72 items were consumed by more than 10% of the group.**	FISH - SEA, CANNED	55.0	9.3
	MAIZE SAMP/RICE & DISHES	52.8	33.5
	BRICK MARGARINE	51.9	3.1
	MAIZE BASED SNACKS -NIKNAKS, CHIPNIKS	51.6	5.9
	COOKIES, LOAVES, PANCAKES, TARTS,CAKES,PUDDING	46.9	7.1
	BEEF SAUSAGE - WORS	46.0	4.6
	COLD DRINK, SQUASH TYPE	44.6	68.4
	SWEETS, HARD BOILED, SOFT JELLY	39.7	2.9
	SAMOOSA, VETKOEK,CHILI BITES, SAVOURY TARTS	39.3	8.7
	BEEF STEW	38.7	9.7
	PEANUT BUTTER; SMOOTH STYLE	35.6	3.3
	TOMATO & ONION STEW, COOKED FRESH	34.8	10.4
	MEAT PRODUCTS & DISHES - BOBOTIE,COTTAGE PIE,PIES,BALLS - COOKED FRESH	34.6	4.4
	CARROT, FLESH AND SKIN, COOKED	30.8	3.9
	TOMATO SAUCE	30.1	2.1
	CHICKEN STEWS, DISHES, PIES	30.0	7.2
	JAM /MARMELADE	29.9	3.0
	SALAD: BEETROOT	29.8	3.5
	SOYBEANS DISHES -IMANA, TOPPERS, MEAL-IN-ONE	29.4	13.5
	SPINACH, COOKED	27.4	9.2
	CUSTARD POWDER, MAIZENA	27.1	3.2
	COLD DRINK, CARBONATED, AVERAGE	27.1	16.4

Table 7 (continued)

	FOOD ITEM	% of group consuming the item	Average per capita g/person/day
Food Frequency:	INSTANT PUDDING POWDER,JELLY	26.7	3.4
	PASTA & NOODLE DISHES	26.6	7.6
	PEAR, RAW	26.1	10.1
	LOW FAT YOGHURT	23.4	8.3
	MUTTON	22.9	2.9
	ROOIBOS TEA	22.7	44.7
	SALAD DRESSING / MAYONNAISE	20.6	1.0
	FISH - SEA, COOKED, FRESH	19.9	2.4
	CHICKEN HEADS & FEET	19.9	2.3
	ORANGE/MINEOLA FRESH (PEELED)	19.6	8.3
	BEEF (STEAKS, FILLET, SIRLOIN)	19.5	2.7
	WILD LEAVES (MAROG, AMARANT, BEETROOT, PUMPKIN)- COOKED	19.4	11.0
	SUNFLOWER OIL	19.2	0.5
	BEANS, SUGAR,KIDNEY,HARRICOT, DRIED	19.1	9.7
	GRAPE, RAW FRESH	18.4	7.3
	MEALIES/SWEETCORN, COOKED FRESH	17.9	7.1
	COFFEE	17.6	24.0
	FULL CREAM ICE CREAM	17.3	3.2
***List of items from most popular to least popular.** ***Only items eaten by at least 10% of the group have been included.** ***Note that 18 items were consumed by more than 50% of the group and 72 items were consumed by more than 10% of the group.**	CHICKEN EGGS DISHES (SCRAMBLE, OMELETTE, SOUFFLE)	17.2	3.5
	PEACH,RAW	17.0	8.3
	CHOCOLATE SWEETS	16.6	1.2
	HIGH FAT CHEESE (CHEDDAR, GOUDA,MOZARELLA)	15.4	0.9
	NON DAIRY CREAMER, ND CONDENSED MILK,ORLEY WHIP	15.2	0.9
	BEEF OFFAL , OTHER (TONGUE, HEART,BRAIN,LUNG,TRIPE)	14.8	2.3
	FULL CREAM PROCESSED MILK, (BUTTERMILK, MAAS)	14.4	19.8
	OATS	14.3	8.7
	POTATO CRISPS	14.2	1.5
	PORK PRODUCTS - HAM, BACON, VIENNA,SALAMI,RUSSIAN - CANNED	14.1	1.7
	SWEET POTATO COOKED WITHOUT SKIN	13.5	2.5
	MALTABELLA/ MABELLA	13.0	17.5
	TOMATO, RAW FRESH	12.8	2.5
	CHUTNEY, CHAKALAKA, ATCHAR	12.2	1.1
	GREEN BEANS, COOKED	11.7	1.4
	MUTTON DISHES - STEWS	11.4	2.8
	ORANGE JUICE (LIQUI FRT/CERES, CANNED/BOTTLED)	10.4	12.2
	SOUP MIX - AVERAGE	10.0	3.5

[a] Adapted from the National Food Consumption Survey (Labadarios et al. 2000)

4.4.4 Differentiation between areas of residence

Since food consumption varies among populations, by age, ethnic group, and/or affordability (WHO 1997a: 15), this report presents tables of most commonly consumed foods according to age and area (urban/rural and provinces) in South Africa. The final tables are regarded as being representative of all ethnic groups and provinces.

4.4.5 Selection of output in final tables

The tables were generated to comprise the following headings:-
The main food group; the subgroup where appropriate; a description of the item where appropriate; the percentage of the sample consuming that item; the portion consumed per day by those individuals who actually consumed the item and the average portion consumed per day (per capita) by all individuals in the relevant sample. The latter portion is smaller because it represents the total quantity consumed divided by the size of the relevant sample. Substantiation for providing both portion sizes is based on WHO (1997b: 5-6) guidelines for calculating the Theoretical Maximum Daily Intake (TMDI) of pesticide residues:

$TMDI = ? MRL_i \times F_i$,

Where MRL_i = Maximum Residue Limit for a given food commodity and
F_i = Per capita GEMS/Food regional consumption of that food commodity.

In this report the commonly consumed food tables have been presented in four different ways for South Africa, urban and rural areas, respectively. These are shown in the results section and include:

a) A comprehensive table of all food items eaten by children and adults;
b) A comprehensive table of all GEMS/Food commodity main groups eaten by children and adults, ranked by popularity;
c) A comprehensive table of all GEMS/Food commodity subgroups eaten by children and adults, ranked by popularity;
d) A table with most commonly consumed food items ranked from items most commonly to those least commonly consumed. These include only items, which were consumed by at least 3% of the sample.

4.5 Calculation of data for adults using 24-hour recalls

4.5.1 Introduction

It was necessary to determine commonly consumed foods for adults, which would be representative of ethnic groups, provinces and areas in South Africa. The NFCS was the only representative database available, however, it only comprised information on children aged 1-9 years. Consequently data from the NFCS were compared with data from existing adult surveys in order to distinguish relationships and patterns, which would allow extrapolation of the existing data to

all provinces. Existing surveys (of adult data) used for this purpose were: Lebowa Study, Dikgale Study, BRISK, and CORIS.

4.5.2 Correlations, factor analyses and equations

Step 1: Correlations

Firstly data from the NFCS were correlated with data from individual surveys on adults. Pearson's correlation coefficients were calculated using both per capita portion sizes and percent of sample consuming the food item, using all items and subgroups consumed. These have been done in the following manner:

- Correlation of Lebowa data with that of NFCS provinces (Table 8)
- Correlation of Dikgale data with that of NFCS provinces (Table 9)
- Correlation of BRISK data with that of NFCS provinces (Table 10)
- Correlation of CORIS data with that of NFCS provinces (Table 11)

Table 8: Correlation coefficients obtained from Pearson's correlations between Lebowa[a] data (age 10+) and NFCS[b] data of 6-9 year-old children, by province

Portion size (POR) or % (PER) of sample consuming item/sub group	**Items or sub groups**	**Best 8 correlations (First two symbols indicate the NFCS province, third symbol: r=rural, u=urban)**							
POR Lebowa	Item N=319	mpr 0.9899	nwu 0.9773	npr 0.9758	fsr 0.9719	fsu 0.9614	nwr 0.9562	kzr 0.9473	gpr 0.94339
PER Lebowa	Item N=319	mpr 0.9394	kzr 0.8866	gpu 0.8773	nwr 0.8428	npu 0.8412	npr 0.8356	nwu 0.8338	gpr 0.8331
POR Lebowa	s.grp N=57	mpr 0.9930	npr 0.9865	nwu 0.9816	fsr 0.9812	ecr 0.9737	fsu 0.9720	gpr 0.9610	nwr 0.9608
PER Lebowa	s.grp N=57	mpr 0.9786	gpr 0.9610	npu 0.9414	gpu 0.9264	kzr 0.9251	ecr 0.9209	npr 0.9153	fsu 0.90378

*Not significant at 99% level, p>0.01

[a] Lebowa Study (Steyn et al. 1992)

[b] National Food Consumption Survey (Labadarios et al. 2000)

Table 9: Correlation coefficients obtained from Pearson's correlations between Dikgale[a] data (age 10+) and NFCS[b] data of 6-9 year-old children, by province

Portion size (POR) or % (PER) of sample consuming item/sub group	Items or sub groups (s.grp)	Best 8 correlations (First two symbols indicate the NFCS province, third symbol: r=rural, u=urban)							
POR Dikgale	Items N=319	mpr 0.9648	nwu 0.9615	kzr 0.9452	gpu 0.9344	fsu 0.9330	nwr 0.9230	npr 0.9186	fsr 0.9128
PER Dikgale	Items N=319	mpr 0.9220	kzr 0.8697	npr 0.8520	nwr 0.8410	nwu 0.8354	fsu 0.8318	gpu 0.8306	npu 0.8185
POR Dikgale	S.grp N=57	mpr 0.9734	npu 0.9646	kzr 0.9618	nwu 0.9595	ecr 0.9595	gpr 0.9576	npr 0.9440	fsu 0.9417
PER Dikgale	S.grp N=57	npr 0.9594	mpr 0.9562	kzr 0.9234	npu 0.9196	ecr 0.9189	gpr 0.9160	fsu 0.8868	nwr 0.8754

*Not significant at 99% level, p>0.01
[a] Dikgale Study (Steyn et al. 1998a)
[b] National Food Consumption Survey (Labadarios et al. 2000)

Table 10: Correlation coefficients obtained from Pearson's correlations between BRISK[a] data (age 10+) and NFCS[b] data of children aged 6-9 years, by province

Portion size (POR) or % (PER) of sample consuming item/subgroup	Items or sub-group	Best 8 correlations (First two symbols indicate the NFCS province, third symbol: r=rural, u=urban)							
POR BRISK	I N=319	ecu 0.7205	kzu 0.7192	ecr 0.6944	gpu 0.6742	mpu 0.6361	wcr 0.6289	ncu 0.6172	kzr 0.6019
PER BRISK	I N=319	ecu 0.8621	kzu 0.8270	gpu 0.8164	mpu 0.8047	wcr 0.7917	ncu 0.7815	wcu 0.7692	ecr 0.7591
POR BRISK	S N=57	kzu 0.9054	ecu 0.8945	gpu 0.8612	mpu 0.8259	ncu 0.8239	wcu 0.8154	nwr 0.8001	kzr 0.7705
PER BRISK	S N=57	kzu 0.9220	wcu 0.9192	ecu 0.9128	gpu 0.9052	mpu 0.8852	wcr 0.8826	ncu 0.8631	kzr 0.8256

*Not significant at 99% level, p>0.01
[a] Black Risk Factor Study (Bourne et al. 1993)
[b] National Food Consumption Survey (Labadarios et al. 2000)

Table 11: Correlation coefficients obtained by Pearson's correlations between CORIS[a] data (age 10+) and NFCS[b] data of children aged 6-9 years, by province

Portion size (POR) or % (PER) of sample consuming item/subgroup	Items or sub-group	Best 8 correlations (First two symbols indicate the NFCS province, third symbol: r=rural, u=urban)							
POR CORIS urban	Item N=319	wcr 0.6471	wcu 0.4812	kzu 0.3768	gpu 0.3751	mpu 0.3709	ecu 0.3691	ncu 0.2667	ecr 0.2586
PER CORIS urban	Item N=31	wcu 0.7883	wcr 0.7606	kzu 0.7199	ncu 0.7144	ecu 0.7133	gpu 0.6999	mpu 0.6787	fsu 0.5923
POR CORIS urban	S.grp N=57	wcr 0.7159	wcu 0.5914	kzu 0.4565	mpu 0.4320	gpu 0.4267	ecu 0.4076	ncu 0.2924*	kzr* 0.2590
PER CORIS urban	S.grp N=57	wcu 0.8776	wcr 0.8101	kzu 0.7894	ecu 0.7640	gpu 0.7625	ncu 0.7555	mpu 0.7550	npu 0.6660
POR CORIS rural	Item N=319	wcr 0.6187	wcu 0.4862	ecu 0.3572	gpu 0.3528	kzu 0.3496	mpu 0.3488	ncu 0.2655	ecr 0.2357
PER CORIS rural	Item N=31	wcu 0.7691	wcr 0.7424	ncu 0.7091	ecu 0.7018	kzu 0.7012	gpu 0.6852	mpu 0.6609	fsu 0.5897
POR CORIS rural	S.grp N=57	wcr 0.6609	wcu 0.5711	kzu 0.4214	gpu 0.3918	ecu 0.3889	mpu 0.3872	ncu* 0.2798	kzr* 0.2372
PER CORIS rural	S.grp N=57	wcu 0.8645	wcr 0.7933	kzu 0.7722	ecu 0.7516	ncu 0.7480	gpu 0.7453	mpu 0.7343	npu 0.6447

*Not significant at 99% level, p>0.01

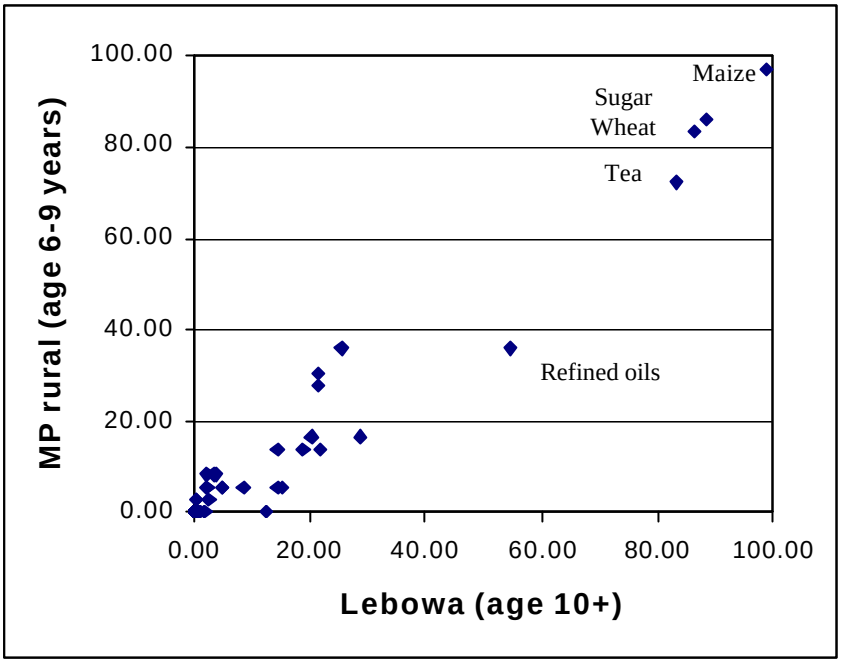
[a] Coronary Risk Factor Study (Wolmarans, unpublished data)

[b] National Food Consumption Survey (Labadarios et al. 2000)

Tables 8-10 illustrate the significant relationships (and correspondence) between the NFCS 6-9 year-olds and those of adults in the Lebowa, Dikgale and BRISK studies. The correlation coefficients varied between 0.7-0.9 and were all significant ($p<0.01$). Figure 1, for example, has illustrated these positive linear associations.

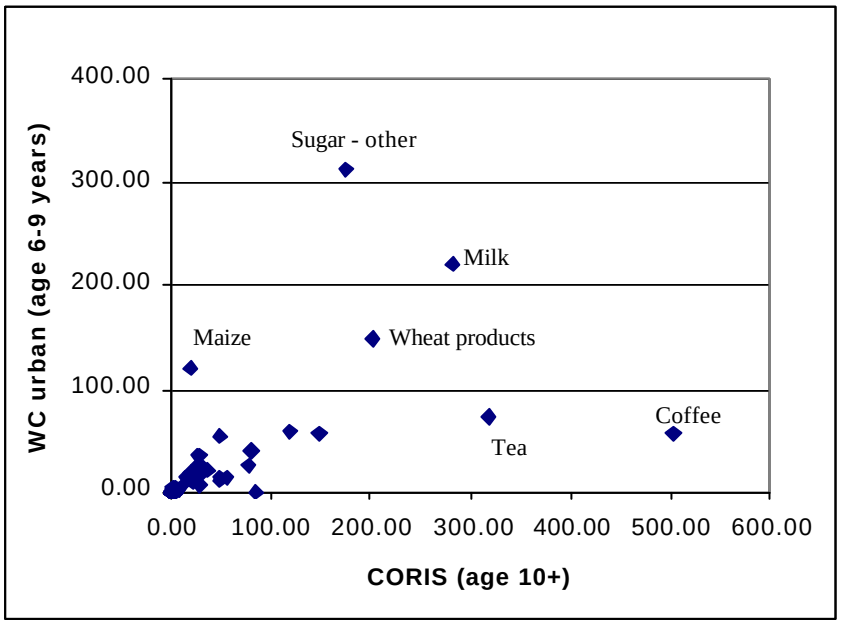
Table 11 however, illustrates a poorer linear association between NFCS 6-9 year-olds and those of adults in the CORIS study. Correlation coefficients were generally much lower and in some instances were not significant (Northern Cape urban and KwaZulu-Natal rural). Since CORIS was undertaken in the Western Cape, this explains the finding that the strongest associations were found with the Western Cape NFCS data. Figure 2, for example, illustrates the association of NFCS (WC) with CORIS data.

Figure 1: Correlation of NCFS[a] Mpumalanga data with Lebowa[b] Study data (based on percentage of participants consuming specific food subgroups)



[a] National Food Consumption Survey (Labadarios et al. 2000)
[b] Lebowa Study (Steyn et al. 1992)

Figure 2: Correlation of NFCS[a] Western Cape data with CORIS[b] data (based on average per capita portion sizes)

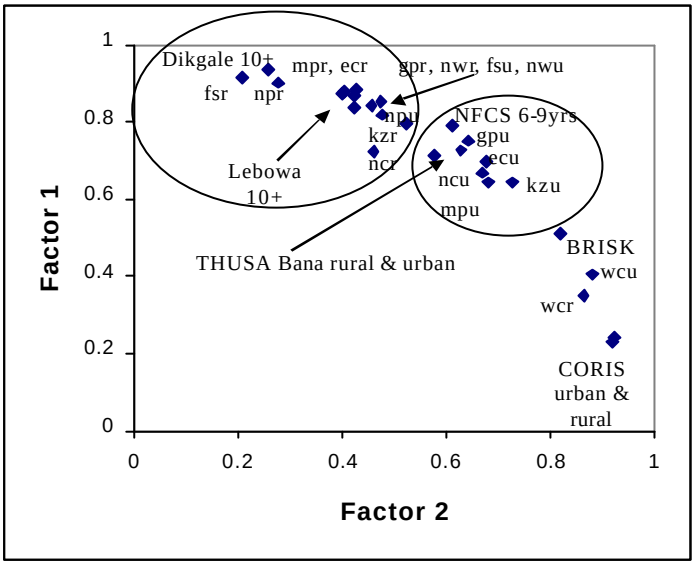


[a] National Food Consumption Survey (Labadarios et al. 2000)
[b] Coronary Risk Factor Study (Wolmarans, unpublished data)

Step 2: Factor analysis

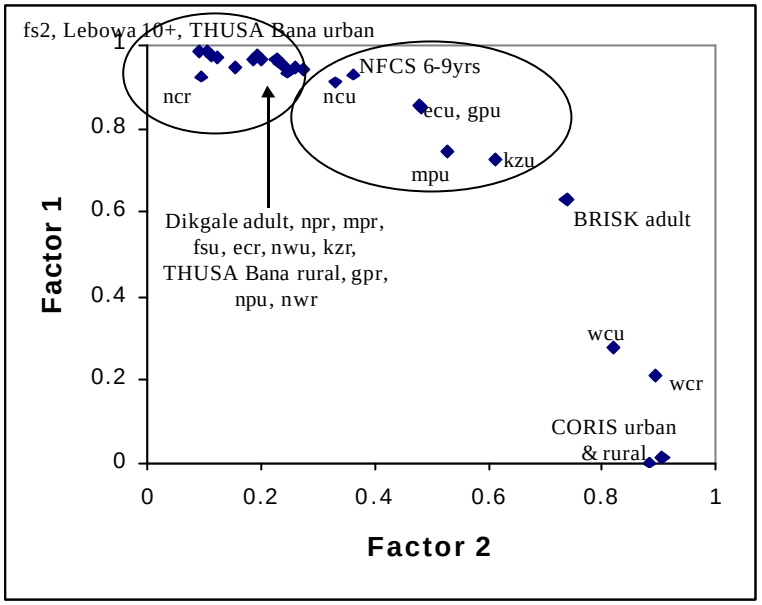
Secondly, relationships between databases were explored by means of factor analyses. This was done to determine whether the adult databases would follow a similar trend with the NFCS as for the "step" on correlations. Factor analyses were done to establish the relationship between NFCS 6-9 year-olds in the nine provinces, urban and rural separately, with the databases having adults, namely: BRISK (10+), Lebowa (10+), CORIS urban and rural (adults), Dikgale (adults) and THUSA Bana, urban and rural. The combined data for RSA NFCS (6-9 year-olds) were also included (Figures 3 and 4). Observations used in this process consisted of the different GEMS/Food subgroups consumed.

Figure 3: Results of factor analysis[a], comparing NFCS 6-9 year-olds with adult data by means of the 24-hour recall[b]: percentage of sample consuming subgroups of food items



[a] Results of factor analysis: rotation = varimax method, total variance explained by factor 1 is 14.2 and by factor 2, is 9.5, the final total communality estimate is 23.7 (out of 26). Only two factors were retained using a minimum eigenvalue of 1.
[b] Sources of studies presented in Table 1.
The first 2 symbols indicate NFCS province, the 3rd symbol indicates rural (r) or urban (u)

Figure 4: Results of factor analysis[a], comparing NFCS 6-9 year-olds with adult data by means of the 24-hour recall[b]: average per capita portion of subgroups consumed



[a] Results of factor analysis: rotation = varimax method, total variance explained by factor 1 is 18.6 and by factor 2, is 5.6, the final total communality estimate is 24.2 (out of 26). Only two factors were retained using a minimum eigenvalue of 1.
[b] Sources of studies presented in Table 1.
The first 2 symbols indicate NFCS province, the 3rd symbol indicates rural (r) or urban (u)

Results from factor analyses showed clearly that factor 1 reflects portion size (especially with regards to maize consumption) and factor 2 reflects number (variety) of different food items consumed.

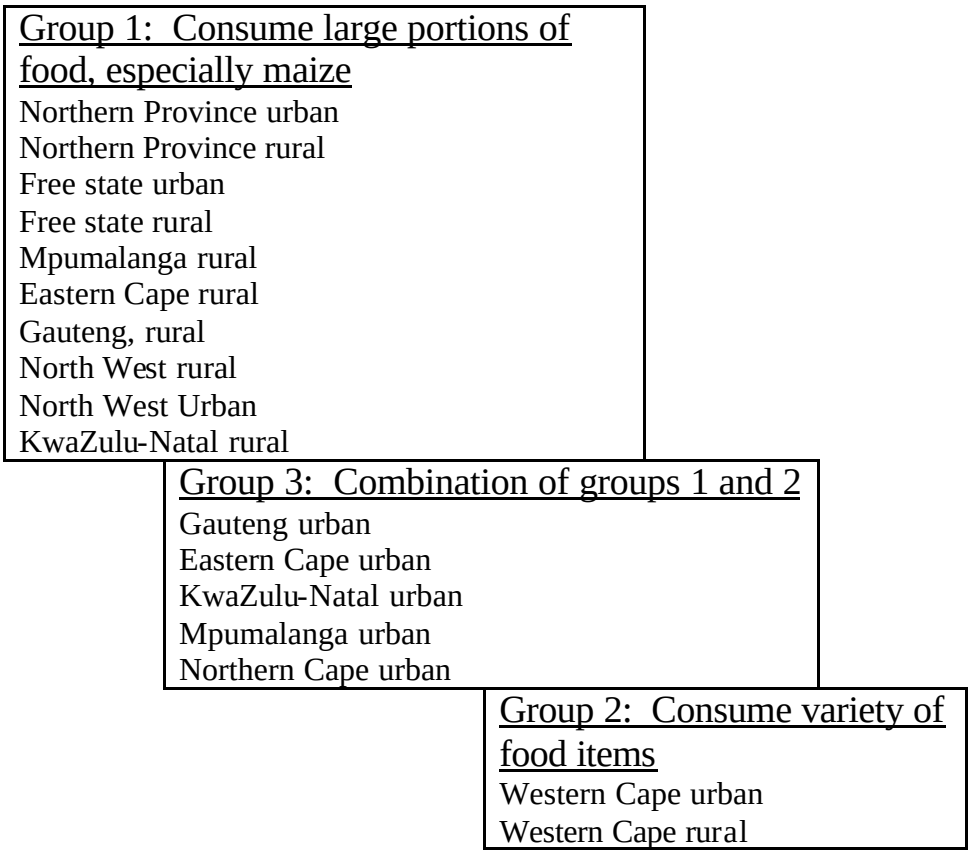
Figure 3 shows trends, which are consistent with the correlations done earlier. Dikgale and Lebowa data clustered together with most NFCS rural areas data. The main urban areas data clustered together in a second corresponding group. Thirdly CORIS, BRISK and Western Cape NFCS data clustered together. Similar results are shown in Figure 4 when average per capita portions of subgroups were used.

The same pattern emerged when factor analyses were done using individual food items as observations. GEMS/Food main groups could not be used since the number was too small.

The final clusters are illustrated visually as Figure 5. Group 1 is regarded as the cluster that consumed large portions of food (specifically maize) and includes: Northern Province (urban and rural), Free State (urban and rural), North West (urban and rural) and rural areas of Mpumalanga, Eastern Cape, Gauteng, and KwaZulu-Natal. Group 2 on the other hand consumed smaller portion sizes yet a large variety of food items. This group includes the Western Cape urban and rural areas. Group 3 formed a cluster, intermediate to group 1 and 2. Group 3 includes all the remaining urban areas: Gauteng, Eastern Cape, KwaZulu-Natal, Mpumalanga and Northern Cape.

Factor analyses have shown that it is possible to combine data from provinces when trying to estimate adult consumption. Available adult data from Dikgale and Lebowa studies appeared adequate to estimate the adult consumption for group 1. However combinations of BRISK, Lebowa, Dikgale and CORIS were required to estimate the consumption of groups 2 and 3. THUSA Bana was not used in further analyses since it only provided data on children up to 18 years and did not vary from the existing databases. Results of the factor analyses in Figures 4 and 5 showed that most rural areas had similar dietary intakes, as did most urban areas.

Figure 5: Arrangement of provinces, by urban and rural, according to similarities in food consumption



Step 3: Weighting of data.

In order to derive equations to determine combined estimates for different population groups, the principle of "weighting" data was applied.

The databases under consideration contained the following variables: The number of participants in the survey (N), the number of subjects (T) consuming a specific food item and the total quantity (Q) (in grams) of the food item consumed per day by the whole group.

From this, the following were calculated: The percentage of the group consuming a specific item (P = T/N); the amount consumed per day by those actually having the item (PORT = Q/T) and the per capita amount consumed (POP_PORT =Q/N).

The equations used and the mathematical relationship between them when weights, w_1 and w_2 were applied, such that $w_1N_1 = w_2N_2$ (or $N_1=w_2N_2/N_1$) have been shown in Table 12. This has been done in order to ensure that two samples will carry an equal weight in the final calculations, irrespective of sample size. A practical example has been given in Table 13 in order to demonstrate the use of the equations.

Table 12: Equations used to calculate a weighted table of food items from two different samples

Variable	Sample 1	Sample 2	Weighted Totals
N (Total in group)	N_1	N_2	$w_1N_1 + w_2N_2 = 2w_1N_1=2w_2N_2$
T (Subjects consuming an item)	T_1	T_2	$w_1T_1 + w_2T_2$
Q (Total amount consumed per day)	Q_1	Q_2	$w_1Q_1 + w_2Q_2$
P = T/N (Percentage consuming the item)	$P_1 = T_1/N_1$	$P_2 = T_2/N_2$	$(w_1T_1 + w_2T_2)/ (w_1N_1 + w_2N_2)$ $w_1T_1/2w_1N_1 + w_2T_2/2w_2N_2$ $=T_1/2N_1 + T_2/2N_2$ $=1/2(T_1/N_1 + T_2/N_2)$ $= ½(P_1 + P_2)$
PORT=Q/T (Amount consumed per day for those having the item)	PORT $=Q_1/T_1$	PORT $=Q_2/T_2$	$(w_1Q_1 + w_2Q_2) / (w_1T_1 + w_2T_2)$ $=(w_1Q_1 + w_2Q_2)/(w_1N_1 + w_2N_2) *$ $(w_1N_1 + w_2N_2)/(w_1T_1 + w_2T_2)$ =POP_PORT / P
PP=POP_PORT=Q/N (Per capita amount consumed)	$PP_1=Q_1/N_1$	$PP_2=Q_2/N_2$	$(w_1Q_1 + w_2Q_2) / (w_1N_1 + w_2N_2)$ $w_1Q_1/2w_1N_1 + w_2Q_2/2w_2N_2$ $=Q_1/2N_1 + Q_2/2N_2$ $=1/2(Q_1/N_1 + Q_2/N_2)$ $=1/2(PP_1 + PP_2)$

Table 13: Examples of applying the equations to calculate a weighted table of food items from two different samples

	EXAMPLE 1			EXAMPLE 2		
	Sample 1	**Sample 2**	**Weighted totals $W_1=2$ $W_2=1$**	**Sample 1**	**Sample 2**	**Weighted totals $W_1=2$ $W_2=1$**
N	50	100	200	50	100	200
T	30	40	100	0	40	40
Q	250g	100g	600g	0	100g	100g
P	60%	40%	50%	0	40%	20%
PORT	8.33g	2.5g	6g	0	2.5g	2.5g
POP_PORT	5g	1g	3g	0	1g	0.5g

Note that in Table 13 the resultant percentage (P) is the average of the two percentages (independent of the sample sizes). Also, the resultant POP_PORT (per capita amount consumed) is the average of the two portion sizes, since it is independent of the sample sizes. However, the resultant portion size of those who actually consumed the food item is calculated by the formula POP_PORT/P, and not taken as the average of the samples.

These formulas and examples can be extended to calculate weighted averages of 2 or more samples.

4.5.3 Methods used to calculate adult data in the provinces

Method 1:

The first method made use of combinations of Lebowa, Dikgale, BRISK and CORIS, in lieu of their positions on the graphs in Figure 3 and Figure 4. The results were regarded to be in line with the results of the NFCS data (over-sampled for subjects living in low socio-economic areas), and did not take ethnic group proportions into consideration for each specific province.

Estimation of Group 1: Adult consumption was estimated by taking the average values of Dikgale and Lebowa adult data. This data formed a pivotal point of Group 1. Dikgale and Lebowa data complemented each other, since the latter represents adolescents and the former adults. Therefore, percentage intake and average portion size per food item / subgroup /main GEMS/Food/commodity for Group 1 were:

$$P_{group\,1} = 0.5(P_{Dikgale}) + 0.5(P_{Lebowa})$$
$$POP\_PORT_{group\,1} = 0.5(PP_{Dikgale}) + 0.5(PP_{Lebowa})$$
$$PORT_{group\,1} = POP\_PORT_{group\,1} / P_{group\,1}$$

These estimates were then applied to NFCS data in the following areas: Northern Province urban, Northern Province rural, Free State urban, Free State rural, Mpumalanga rural, Eastern Cape rural, Gauteng rural, North West rural, North West urban and KwaZulu-Natal rural.

Estimation of Group 2: CORIS data represented the white population of the Western Cape, and BRISK data represented the black population of the Western Cape. Because of the similarities between CORIS urban and rural data, the combined databases were used in further analyses. It was accepted that white and "coloured" populations in Western Cape have similar dietary patterns (Steyn 1988). Adult dietary intake for the Western Cape was calculated as the weighted average of CORIS and BRISK, using the ratio of black versus non-black residents in the Western Cape as described in Table 14, as follows:

$$P_{group\,2} = 0.79(P_{CORIS}) + 0.21(P_{BRISK})$$
$$POP\_PORT_{group\,2} = 0.79(PP_{CORIS}) + 0.21(PP_{BRISK})$$
$$PORT_{group\,2} = POP\_PORT_{group\,2} / P_{group\,2}$$

Group 2 estimates were used to estimate adult consumption for the Western Cape as a whole.

Table 14: Proportion of urban and rural populations per province, and the proportion of non-black subjects in the NFCS[a]

Province	Race Group	Urban (Stats SA)	Rural (Stats SA)	Proportion of non-black subjects according to Stats SA[b]	Proportion of non-black subjects according to NFCS[a]
Western Cape (WC)	Black	0.199	0.010	0.791	0.80
	Other	0.690	0.101		
	Total urban/rural	0.889	0.111		
Eastern Cape (EC)	Black	0.248	0.616	0.136	0.05
	Other	0.118	0.018		
	Total urban/rural	0.366	0.634		
Northern Cape (NC)	Black	0.259	0.072	0.669	0.33
	Other	0.444	0.225		
	Total urban/rural	0.703	0.297		
Free State (FS)	Black	0.553	0.292	0.155	0.04
	Other	0.134	0.021		
	Total urban/rural	0.687	0.313		
KwaZulu-Natal (KZ)	Black	0.263	0.554	0.183	0.05
	Other	0.170	0.013		
	Total urban/rural	0.433	0.567		
North West (NW)	Black	0.289	0.624	0.087	0.00
	Other	0.065	0.022		
	Total urban/rural	0.354	0.646		
Gauteng (GP)	Black	0.680	0.021	0.299	0.10
	Other	0.290	0.009		
	Total urban/rural	0.970	0.030		
Mpumalanga (MP)	Black	0.304	0.587	0.108	0.04
	Other	0.087	0.021		
	Total urban/rural	0.391	0.608		
Northern Province (NP)	Black	0.095	0.872	0.033	0.00
	Other	0.016	0.017		
	Total urban/rural	0.111	0.889		

[a] National Food Consumption Survey (Labadarios et al. 2000)
[b] Central Statistical Services (1999)

Estimation of Group 3: This group fell between the Lebowa/Dikgale combination and the BRISK database. The average of BRISK and the combined average of Lebowa and Dikgale were used to estimate adult consumption for this group as follows:

$$P_{group\,3} = 0.25(P_{Lebowa}) + 0.25(P_{Dikgale}) + 0.5(P_{BRISK})$$
$$POP\_PORT_{group\,3} = 0.25(PP_{Lebowa}) + 0.25(PP_{Dikgale}) + 0.5(PP_{BRISK})$$
$$PORT_{group\,3} = POP\_PORT_{group\,3} / P_{group\,3}$$

These estimates were applied to the urban areas of: Gauteng, Eastern Cape, KwaZulu-Natal, Mpumalanga and Northern Cape.

Urban and rural intakes were combined to produce a single adult estimate per province, using the ratios between urban and rural per province, as given in Table 14. For each province the following equations were used:

Eastern Cape = *(0.366*group3 + 0.634*group1)*
Free State = *(0.687*group1 + 0.313*group1)*
Gauteng = *(0.970*group3 + 0.030*group1)*
KwaZulu-Natal = *(0.433*group3 + 0.567*group1)*
Mpumalanga = *(0.391*group3 + 0.609*group1)*
Northern Cape = *(0.703*group3 + 0.297*group1)*
Northern Province = *(0.111*group1 + 0.889*group1)*
North West = *(0.354*group1 + 0.646*group1)*
Western Cape = *(0.889*group2 + 0.111*group2)*

Method 2:

The second method of estimating adult consumption utilised the fact that adult data was available for black rural, black urban, white rural and white urban populations. The food intake per province was estimated by taking the proportion of ethnic groups (black versus non-black) per province into consideration.

The average of Lebowa and Dikgale data were the same as group 1 (in method 1), namely:

$$P_{EC} = (0.118*P_{CORIS\,urban} + 0.018*P_{CORIS\,rural} + 0.248*_{PBRISK} + 0.616*P_{group\,1})$$
$$P_{FS} = (0.134*P_{CORIS\,urban} + 0.021*P_{CORIS\,rural} + 0.553*_{PBRISK} + 0.292*P_{group\,1})$$
$$P_{GP} = (0.290*P_{CORIS\,urban} + 0.009*P_{CORIS\,rural} + 0.680*_{PBRISK} + 0.021*P_{group\,1})$$
$$P_{KZ} = (0.170*P_{CORIS\,urban} + 0.013*P_{CORIS\,rural} + 0.263*_{PBRISK} + 0.554*P_{group\,1})$$
$$P_{MP} = (0.087*P_{CORIS\,urban} + 0.021*P_{CORIS\,rural} + 0.304*_{PBRISK} + 0.587*P_{group\,1})$$
$$P_{NC} = (0.444*P_{CORIS\,urban} + 0.225*P_{CORIS\,rural} + 0.259*_{PBRISK} + 0.072*P_{group\,1})$$
$$P_{NP} = (0.016*P_{CORIS\,urban} + 0.017*P_{CORIS\,rural} + 0.095*_{PBRISK} + 0.872*P_{group\,1})$$
$$P_{NW} = (0.065*P_{CORIS\,urban} + 0.022*P_{CORIS\,rural} + 0.289*_{PBRISK} + 0.624*P_{group\,1})$$
$$P_{WC} = (0.690*P_{CORIS\,urban} + 0.101*P_{CORIS\,rural} + 0.199*_{PBRISK} + 0.010*P_{group\,1})$$

$$POP\_PORT_{EC} = (0.118*PP_{CORIS\,urban} + 0.018*PP_{CORIS\,rural} + 0.248*PP_{BRISK} + 0.616*PP_{group\,1})$$
$$POP\_PORT_{FS} = (0.134*PP_{CORIS\,urban} + 0.021*PP_{CORIS\,rural} + 0.553*PP_{BRISK} + 0.292*PP_{group\,1})$$
$$POP\_PORT_{GP} = (0.290*PP_{CORIS\,urban} + 0.009*PP_{CORIS\,rural} + 0.680*PP_{BRISK} + 0.021*PP_{group\,1})$$
$$POP\_PORT_{KZ} = (0.170*PP_{CORIS\,urban} + 0.013*PP_{CORIS\,rural} + 0.263*PP_{BRISK} + 0.554*PP_{group\,1})$$
$$POP\_PORT_{MP} = (0.087*PP_{CORIS\,urban} + 0.021*PP_{CORIS\,rural} + 0.304*PP_{BRISK} + 0.587*PP_{group\,1})$$
$$POP\_PORT_{NC} = (0.444*PP_{CORIS\,urban} + 0.225*PP_{CORIS\,rural} + 0.259*PP_{BRISK} + 0.072*PP_{group\,1})$$
$$POP\_PORT_{NP} = (0.016*PP_{CORIS\,urban} + 0.017*PP_{CORIS\,rural} + 0.095*PP_{BRISK} + 0.872*PP_{group\,1})$$
$$POP\_PORT_{NW} = (0.065*PP_{CORIS\,urban} + 0.022*PP_{CORIS\,rural} + 0.289*PP_{BRISK} + 0.624*PP_{group\,1})$$
$$POP\_PORT_{WC} = (0.690*PP_{CORIS\,urban} + 0.101*PP_{CORIS\,rural} + 0.199*PP_{BRISK} + 0.010*PP_{group\,1}).$$

The portion sizes for those actually consuming the food were obtained by dividing the average portion for the whole province (POP_PORT values) by the percentage of those consuming the food (P) in that province.

4.5.4 Final equations used to estimate adult intake for South Africans

Adult intakes (average per capita portion size and percentage of adults consuming the item) in South Africa (RSA) were estimated by applying weights according to proportion of populations in each province (Table 15), as follows:

*RSA = 0.15*EC + 0.07*FS + 0.18*GP + 0.21*KZ + 0.07*MP + 0.02*NC + 0.12*NP + 0.08*NW + 0.10*WC;*

*RSA(rural) = 0.21*EC + 0.05*FS + 0.01*GP + 0.26*KZ + 0.09*MP + 0.01*NC + 0.23*NP + 0.12*NW + 0.02*WC;*

*RSA(urban) = 0.11*EC + 0.08*FS + 0.33*GP + 0.17*KZ + 0.05*MP +0.03*NC + 0.02*NP + 0.05*NW + 0.16*WC.*

This was further simplified in terms of the original databases to:

Method 1:

*RSA = 0.3606*Lebowa + 0.3606*Dikgale + 0.2022*BRISK + 0.0766*CORIS;*

*RSA(rural) = 0.49*Lebowa + 0.49*Dikgale + 0.004*BRISK + 0.016*CORIS*

*RSA(urban) = 0.248*Lebowa + 0.248*Dikgale + 0.379*BRISK + 0.126*CORIS*

Method 2:

*RSA = 0.2043*CORIS(urban) + 0.0283*CORIS(rural) + 0.3332*BRISK + 0.2171*Lebowa + 0.2171*Dikgale;*

*RSA(rural) = 0.062*CORIS(rural) + 0.469*Lebowa + 0.469*Dikgale;*

*RSA(urban) = 0.38*CORIS(urban) + 0.62*BRISK.*

Table 15: Population proportions per province in South Africa (in thousands)

	Province								
	EC	**FS**	**GP**	**KZ**	**MP**	**NC**	**NP**	**NW**	**WC**
RSA[a]	0.15	0.07	0.18	0.21	0.07	0.02	0.12	0.08	0.10
RURAL[b]	0.21	0.05	0.01	0.26	0.09	0.01	0.23	0.12	0.02
URBAN[b]	0.11	0.08	0.33	0.17	0.05	0.03	0.02	0.05	0.16

[a] Statistics South Africa (2000a)
[b] Central Statistical Services (1999)

The weightings were adjusted for the sample sizes of the source data. The adjusted relative weightings used to estimate adult intakes were calculated as follows:

Table 16: Calculation of adjusted relative weightings used to calculate intakes of South African adults

Group	Steps	Data Sets[b]			
		Dikgale	Lebowa	BRISK	CORIS
RSA (Method 1)[a] N = 3535	A=Weighting of data set[a]	0.3606	0.3606	0.2022	0.0766
	B=Sample size	216	292	1243	1784
	Adjusted relative weighting =(A*3535)/B	5.901	4.365	0.575	0.152
RSA Urban (Method 1)[a] N = 3535	A=Weighting of data set[a]	0.248	0.248	0.379	0.126
	B=Sample size	216	292	1243	1784
	Adjusted relative weighting =(A*3535)/B	4.059	3.002	1.078	0.250
RSA Rural (Method 1)[a] N = 3535	A=Weighting of data set[a]	0.490	0.490	0.004	0.016
	B=Sample size	216	292	1243	1784
	Adjusted relative weighting =(A*3535)/B	8.019	5.932	0.011	0.032

Group	Steps	Data Sets[b]				
		Dikgale	Lebowa	BRISK	CORIS Urban	CORIS Rural
RSA (Method 2)[a] N = 3535	A=Weighting of data set[a]	0.2171	0.2171	0.3332	0.204	0.028
	B=Sample size	216	292	1243	1125	659
	Adjusted relative weighting =(A*3535)/B	3.553	2.628	0.948	0.642	0.152
RSA Urban (Method 2)[a] N = 2368	A=Weighting of data set[a]	-	-	0.620	0.380	-
	B=Sample size	-	-	1243	1125	-
	Adjusted relative weighting =(A*2368)/B	-	-	1.181	0.800	-
RSA Rural (Method 2)[a] N = 1167	A=Weighting of data set[a]	0.469	0.469	-	-	0.062
	B=Sample size	216	292	-	-	659
	Adjusted relative weighting =(A*1167)/B	2.534	1.874			0.110

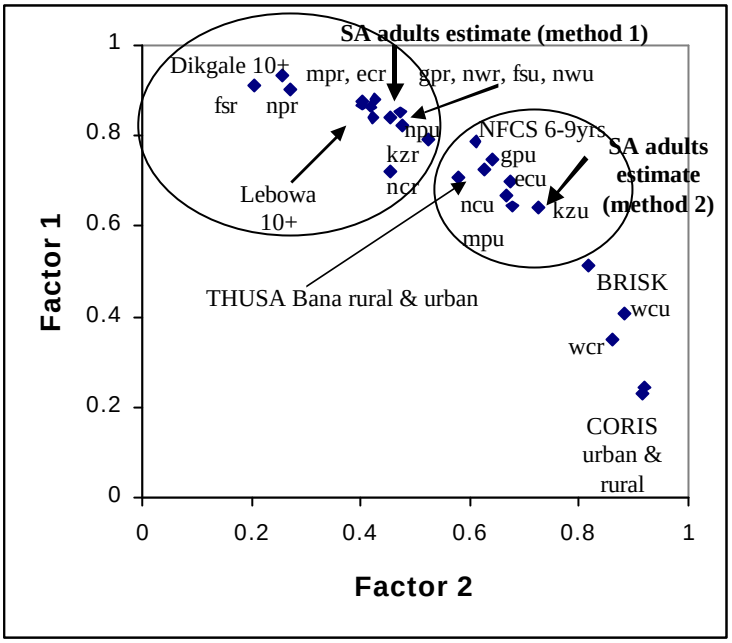
[a] See paragraph 4.5.4
[b] Sources of studies presented in Table 1

The adjusted relative weightings were applied when calculating the weighted means and 97.5th percentile of the daily consumption of food items of those actually consuming the food items, the weighted means of the per capita consumption and the percentage of the group consuming the respective items. The calculations were explained in Table 12.

Formulae developed for methods 1 and 2 were applied to the databases in order to estimate intake for adults (10 +) in South Africa. Two variables, the percentage of population consuming food items from a certain subgroup, and the average per capita portion size of the population of a specific subgroup, were calculated by each method. Factor analyses were repeated, adding the newly created databases (method 1 and method 2 adults) to the set of variables.

Figures 3 and 4 are displayed again, showing the position of the percentage of adults consuming various subgroups and average per capita portion sizes for the population, but this time including the position of South African adults as calculated by method 1 and method 2, respectively (Figures 6 and 7).

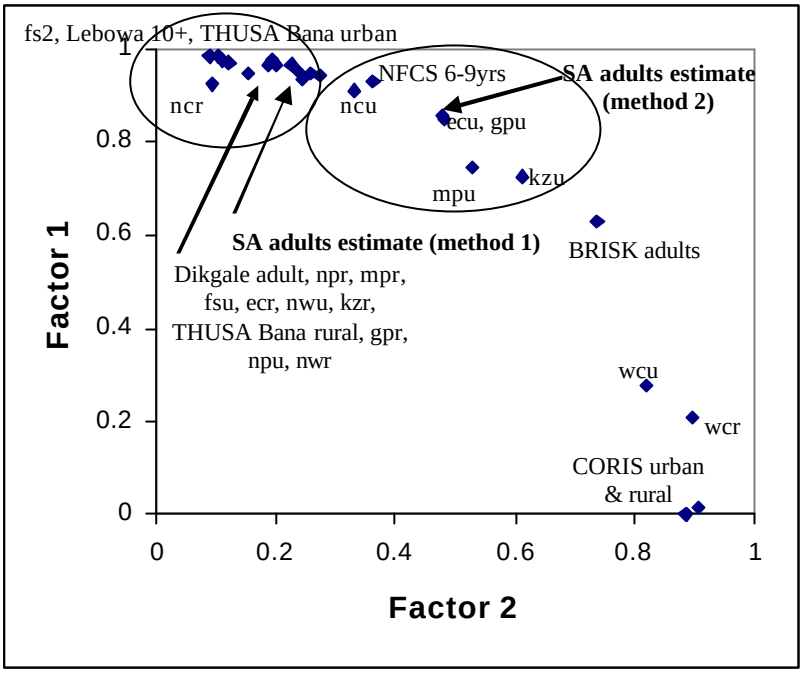
Figure 6: Results of factor analysis[a], comparing NFCS 6-9 year-olds with adult data by means of the 24-hour recall[b]: percentage of sample consuming subgroups of food items



[a] Results of factor analysis adding method 1: rotation = varimax method, total variance explained by factor 1 is 13.9 and by factor 2, is 9.0, the final total communality estimate is 22.9 (out of 25, excluding THUSA Bana urban and THUSA Bana rural). Only two factors were retained using a minimum eigenvalue of 1.
[a] Results of factor analysis adding method 2: rotation = varimax method, total variance explained by factor 1 is 14.6 and by factor 2, is 10.1, the final total communality estimate is 24.7 (out of 27). Only two factors were retained using a minimum eigenvalue of 1.
[b] Sources of studies presented in Table 1.

The first 2 symbols indicate NFCS province, the 3rd symbol indicates rural (r) or urban (u)

Figure 7: Results of factor analysis[a], comparing NFCS 6-9 year-olds with adult data by means of the 24-hour recall[b]: average per capita portion of subgroups consumed



[a] Results of factor analysis adding method 1: rotation = varimax method, total variance explained by factor 1 is 16.8 and by factor 2, is 5.4, the final total communality estimate is 22.2 (out of 24, excluding THUSA Bana urban and THUSA Bana rural and NFCS, 6-9 year-olds). Only two factors were retained using a minimum eigenvalue of 1.
[a] Results of factor analysis adding method 2: rotation = varimax method, total variance explained by factor 1 is 19.3 and by factor 2, is 5.8, the final total communality estimate is 25.1 (out of 27). Only two factors were retained using a minimum eigenvalue of 1.
[b] Sources of studies presented in Table 1.
The first 2 symbols indicate NFCS province, the 3rd symbol indicates rural (r) or urban (u)

In both figures, method 1 showed that average South African adult consumption was closely related to that of consumption in most rural communities in South Africa, while the results of method 2 related more closely to that of urban consumption studies. Note also that adult (RSA) estimates, calculated from adult data from Lebowa, Dikgale, CORIS and BRISK, are similar to data obtained for the NFCS (6-9 year-olds). Method 1 provided a closer estimate to NFCS (6-9 year-olds), with respect to portion size whereas method 2 provided a bigger variety in food items consumed by adults, due to the inclusion of white consumers in all provinces.

Similar results were obtained when factor analyses were performed, using individual food items as observations rather than GEMS/Food subgroups.

4.6 Calculation of data for adults using the food frequency method

Databases generated by means of the food frequency method included: NFCS, THUSA, WRFS and the FYFS Project. In order to establish relationships/ associations between the NFCS and the other studies (databases) used, factor analyses were undertaken using the same methods as discussed in 4.5.2. These are shown in Figures 8 and 9.

Again, the same consumption patterns emerged amongst different areas and provinces: the "poorer" rural provinces were clustered together on factor 1 (consume large quantities, especially maize) and the Western Cape groups clustered together on factor 2 (large variety of items consumed).

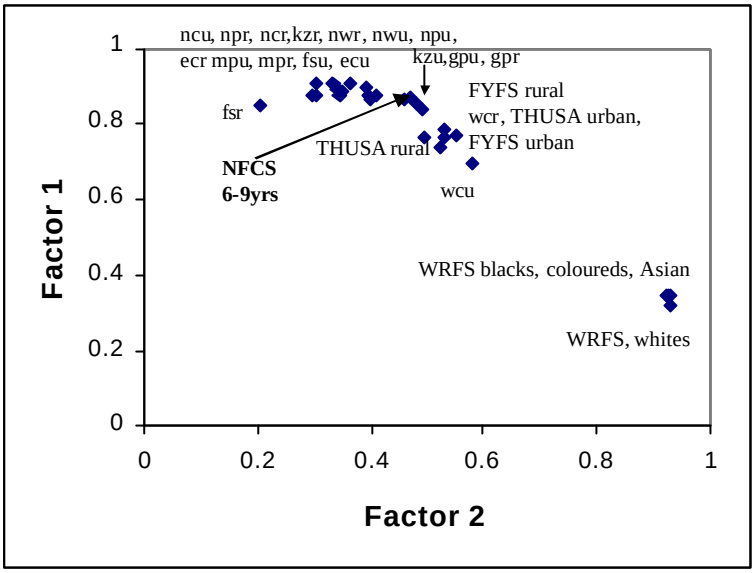
The ethnic groups of the WRFS (blacks: n = 111; coloureds: n = 71; Asians: n = 50; whites: n = 216) appeared to have similar dietary consumption patterns to the NFCS Western Cape subjects. They were clustered around factor 1 which represented a large variety of items consumed. The main reason postulated for this is the fact that WRFS participants were employed (economically active) adults. Consequently they did not represent the overall populations of South Africa (33.9% unemployment) (Statistics South Africa 2000a)

Data from the FYFS (urban and rural respectively) showed similar tendencies to the NFCS data when considering percentage of the groups consuming specific food subgroups (Figure 8). However with respect to per capita portion sizes consumed, urban and rural groups clustered around the NFCS "rural" groups (Figure 9).

THUSA urban and rural data were similar to most of the NFCS urban groups for both the percentage of the population consuming subgroups (Figure 8) and the average per capita portion size consumed (Figure 9).

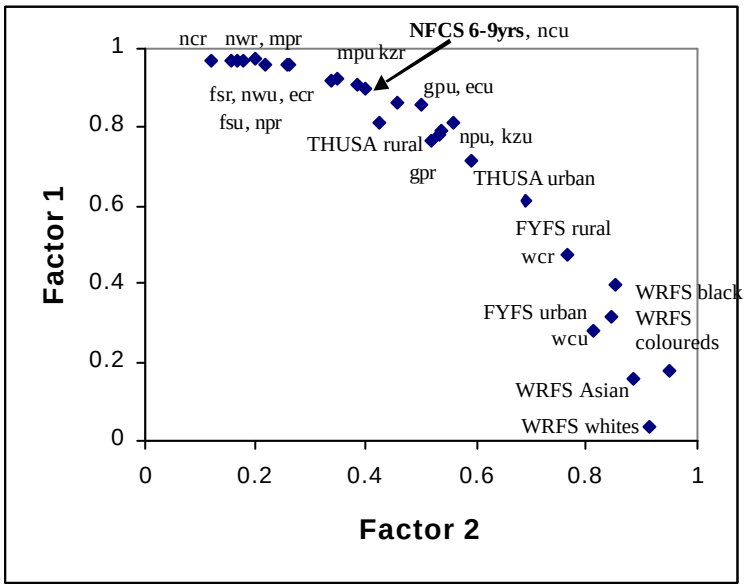
With respect to databases using the food frequency method it was difficult to extrapolate a combined database for adults, since the nature of the available databases differed completely. THUSA data were collected by means of a culture-sensitive quantified food frequency questionnaire (MacIntyre et al. 2000b), WRFS data were obtained from a postal semi-quantitative food frequency questionnaire completed personally by each subject (Senekal et al. 2002), and participants in the FYFS were interviewed by trained fieldworkers according to a simplified version of a quantified frequency questionnaire (Steyn et al. 2000a; Steyn et al. 2000b). Nevertheless, the results on commonly consumed food items derived from each food frequency study have been reported under the results section.

Figure 8: Results of factor analysis[a], comparing NFCS 6-9 year-olds with adult data by means of the food frequency method[b]: percentage of sample consuming subgroups of food items



[a] Results of factor analysis: rotation = varimax method, total variance explained by factor 1 is 17.0 and by factor 2, is 7.6, the final total communality estimate is 24.6 (out of 27). Only two factors were retained using a minimum eigenvalue of 1.
[b] Sources of the studies presented in Table 1.
The first 2 symbols indicate NFCS province, the 3rd symbol indicates rural (r) or urban (u)

Figure 9: Results of factor analysis[a], comparing NFCS 6-9 year-olds with adult data by means of the food frequency method[b]: average per capita portions of subgroups consumed



[a] Results of factor analysis: rotation = varimax method, total variance explained by factor 1 is 16.2 and by factor 2, is 8.6, the final total communality estimate is 24.8 (out of 27). Only two factors were retained using a minimum eigenvalue of 1.
[b] Sources of the studies presented in Table 1.
The first 2 symbols indicate NFCS province, the 3rd symbol indicates rural (r) or urban (u)

4.7 Comparison of food subgroups with food balance sheets for South Africa

Food balance sheets for South Africa were derived by taking the total production of a specific food item in the country, and by subtracting the total amount used for animal feed as well as the total amounts of imports and exports; the remainder reflects net human consumption of that specific subgroup (Steyn et al. 2001a). This amount was then divided by the total population count and the final amount was assumed to represent the individual (per capita) consumption of a given food. This amount reflects a crude result since it does not take wastage; losses as result of storage; urban/rural distribution or intra-household distribution into account.

According to the WHO (1997a), food balance sheets over-estimate food consumption of populations by about 15% compared with actual consumption. Another disadvantage of food balance sheets, particularly in developing countries, is the fact that they do not take home grown crops and animal husbandry into consideration. They are, however, regarded as a useful tool for comparing food and beverage consumption of different countries in a fairly crude manner.

4.8 Inclusion of water

Bourne (1986) classified water sources into the following:

A. Water from taps: this is found in drinking water, and all commodities which have added tap water, such as: coffee/tea, soup, and stews.
B. Commercial beverages: such as beer, soft drinks, mineral water.
C. Bound-water found in all foods such as natural juices, milk, meat and bread.

In a study conducted on households in the Western Cape, Bourne (1986) found that tap water consumption ranged between 340 ml and 1618ml, depending on age and ethnic group studied (Table 17). These results excluded commercial beverages and water bound in food. However it did include tap water added to foods and drinks (A). In Table 18 the results on drinking water (only) have been shown, taken from the BRISK study. This represents water that was drunk from a tap with nothing added. Since the other databases used in this report did not include water (only) consumption, it was necessary to add tap water to the final list required for pesticide analyses. Since the BRISK data represent the only South African data on tap water consumed over and above that in beverages and food, it is recommended that these average means be used for analyses of contaminants.

Table 17: Tap water consumed by white and "coloured" participants in Cape Town[a]

Ethnic group		Age groups						
		0	**1-4**	**5-11**	**12-17**	**18-30**	**31-54**	**55+**
White males	Mean	577	534	800	1105	1534	1506	1618
	Std Err	146	64	60	64	102	50	83
	N	10	50	125	137	118	268	89
White females	Mean	340	552	682	978	1418	1624	1548
	Std Err	131	62	47	53	76	45	82
	n	12	47	129	110	157	353	97
Coloured males	Mean	622	393	594	892	976	1066	1066
	Std Err	82	42	25	54	49	60	62
	n	22	56	106	62	128	100	45
Coloured females	Mean	535	398	540	758	928	1084	962
	Std Err	101	34	28	38	36	46	47
	n	24	46	92	81	166	146	60

[a] Bourne (1986)

Table 18: Average consumption of drinking water per age group found in BRISK[a]

Age group	1-5	6-9	10+
BRISK drinking water	174.6 ml	209.3 ml	304.0 ml

[a] Black Risk Factor Study (Bourne et al. 1993)

4.9 Body weight of South Africans

In order to determine levels of dietary exposure to contaminants it is necessary to know the average body weight of the target population being studied.

In general, the equation for both acute and chronic dietary exposure can be expressed as follows (WHO 1997a: 10):

*Dietary Exposure=(Food Chemical Concentration*Consumption)/(Body Weight).*

Measures of central tendency (mean, median) and dispersion (standard deviation, Q1 and Q3) for body weight have, for the purpose of this study, been reported for each individual survey, by gender and age group.

The discussion to follow distinguishes between "weight (in grams)" of subjects and "relative weighting " (to describe relativity of different samples)

Statistics for weights (in grams) of South African children, 1-5 year-olds and 6-9 year-olds, are taken directly from the NFCS (Labadarios et al. 2000). The statistics for weights (in grams) of adults were calculated using the relative weightings calculated in paragraph 4.5.4, that were used to determine the dietary intake of adults by combining different datasets.

The relative weightings, as described in paragraph 4.5.4 for method 1 and method 2, RSA, RSA urban and RSA rural, were adjusted for the sample sizes, before being applied.

The following shows how the relative weightings were adjusted:

Table 19: Calculation of adjusted relative weightings used to calculate weights (in grams) of South African adults

Group	Steps	Data Sets[b]				
		Dikgale	**Lebowa**	**BRISK**	**CORIS**	
RSA (Method 1) N = 8811	A=Weighting of data set[a]	0.3606	0.3606	0.2022	0.0766	
	B=Sample size	111	300	1143	7257	
	Adjusted relative weighting =(A*8811)/B	28.624	10.591	1.559	0.0930	
RSA Urban (Method 1) N = 8811	A=Weighting of data set[a]	0.248	0.248	0.379	0.126	
	B=Sample size	111	300	1143	7257	
	Adjusted relative weighting =(A*8811)/B	19.686	7.284	2.922	0.153	
RSA Rural (Method 1) N = 8811	A=Weighting of data set[a]	0.490	0.490	0.004	0.016	
	B=Sample size	111	300	1143	7257	
	Adjusted relative weighting =(A*8811)/B	38.895	14.391	0.031	0.019	
Group	**Steps**	**Dikgale**	**Lebowa**	**BRISK**	**CORIS Urban**	**CORIS Rural**
RSA (Method 2) N = 8803	A=Weighting of data set[a]	0.2171	0.2171	0.3332	0.2043	0.0283
	B=Sample size	111	300	1143	4791	2458
	Adjusted relative weighting =(A*8803)/B	17.217	6.370	2.566	0.3754	0.1014
RSA Urban (Method 2) N = 5934	A=Weighting of data set[a]	-	-	0.620	0.380	-
	B=Sample size	-	-	1143	4791	-
	Adjusted relative weighting =(A*5934)/B	-	-	3.219	0.471	-
RSA Rural (Method 2) N = 2869	A=Weighting of data set[a]	0.469	0.469	-	-	0.062
	B=Sample size	111	300	-	-	2458
	Adjusted relative weighting =(A*2869)/B	12.122	4.485			0.072

[a] See paragraph 4.5.4
[b] Sources of studies presented in Table 1

The adjusted relative weightings were applied when calculating the weighted means, standard deviation, median, Q1 and Q3 for weight (in grams) for South African adults. Because of huge differences in sample sizes, standard deviations obtained were large.