CHAPTER 6:

DIETARY INTAKE: QUANTITATIVE FOOD FREQUENCY METHOD

U MacIntyre, D Labadarios

Introduction

The measurement of dietary intake of individuals and groups is central to nutrition research[1,2]. Dietary assessment methodologies may be broadly classified into two categories: those for the measurement of the intake of groups or households and those for the assessment of individual intake. Included under the former, are techniques such as the food procurement and household inventory method, which is presented in Chapter 7 of this report. Individual dietary assessment methodologies include the diet history, 24-hour recall (24-H-R), weighed and estimated food records and food frequency questionnaires. For the purposes of this survey, two methods of individual dietary assessment were used, namely the 24-hour recall, which was presented in Chapter 5 of this report, and the Quantitative Food Frequency Questionnaire (QFFQ), which is the subject of this Chapter of the report.

A food frequency questionnaire comprises a list of foods and beverages on which respondents report their usual frequency of consumption over a given period. Semi-quantitative food frequency questionnaires include estimates of portion sizes such as small, medium or large or in comparison to a “standard” serving size. The quantitative food frequency includes more precise food portion size estimations such as weight, volume or household measures[3-5]. Energy, nutrient and food intake are obtained by summing the reported frequency multiplied by the amount consumed over all reported foods and expressed in grams consumed per day. In contrast to the 24-hour recall that does not characterise an individual’s usual diet and underestimates intakes, the food frequency method provides an estimate of the usual intake of an individual over a given period and may be used to rank individuals according to usual intake within the population. The food frequency method does, however, have the following limitations[3-5]:

- Estimation of food quantities may not be as accurate as the recall method. A food frequency questionnaire, therefore, may over or underestimate dietary intakes.

- Detailed information on the day-to-day variation in the diet cannot be collected
- Results may be influenced by the foods included in the lists
- A food frequency questionnaire developed for one population may not be suitable for use in other populations.

Most dietary assessment methods have been developed, tested and used in adult populations. A particular difficulty in collecting dietary data from young children is that their dietary intake has to be reported by a parent or caregiver, so that, in effect, the information reported is 'second' hand. In addition, the parent or caregiver may not be aware of foods eaten by the child away from home[6]. In order to ameliorate the effects of these disadvantages, it is essential that a food frequency questionnaire is developed for the target population and that the relative validity and reproducibility are thoroughly tested within the population to be studied.

Methodology

Development of the Quantitative Food Frequency Questionnaire

As one of the purposes of this national survey was to quantify food and nutrient intake, it was necessary to use a Quantitative Food Frequency Questionnaire (QFFQ). The latter, would not only give information on the frequency of consumption of foods and nutrients but also on the amounts of foods eaten as well as data on the energy and nutrient intake of the target population. Quantification of portion sizes was achieved by means of food models as well as by using household measuring utensils such as various sizes of cups, spoons and food items (see also Chapter 2 and 5 of this report).

The QFFQ for use in the survey had to meet the following criteria:

- It should be easy to administer by the field workers
- It should be understood by the respondent (parent or caregiver)

- It should cover all commonly consumed foods and drinks, which are consumed by children of all population groups and at all levels of urbanisation
- It should help the respondent to quantify food intake
- It should limit both over- and under-estimation
- It should be easy to code and computerise
- It should be reproducible and relatively valid.

The QFFQ was developed from the instrument used to assess the dietary intake of adult Africans in the North West Province for the Transition, Health, Urbanisation in South Africa (THUSA) study[7]. Since the original QFFQ was developed for a specific adult population, it was necessary to modify and test it in the target population. Initial modification of the QFFQ was the expansion of the food list to include foods eaten by all population groups with specific emphasis on foods eaten by toddlers and children such as infant formulae, cereals and commercial purees.

The relative validity of the QFFQ was tested by comparison with three-day weighed food records on samples of convenience drawn from the Northern Province and the Western Cape. Following the analysis of the validation results, the QFFQ was further modified by suggestions from all the Directors of this survey. The final QFFQ (Appendix: Questionnaires) comprised 122 food items, each with one or more descriptions, divided into 13 food groups:

- maize meal
- other cooked porridges
- breakfast cereals
- starches
- bread and bread spread
- meat and fish
- eggs
- vegetables

- fruit
- drinks
- puddings, cakes and sweets
- snacks and condiments
- sauces

The descriptions and preparation methods given on the list were those known to be the most usual preparation methods of the population[7]. The groups were ranked from foods most frequently consumed by most of the population (maize meal) to those expected to make a relatively small contribution to the diet (puddings, snacks, sweets, cakes and condiments). A verification question asking for the total number of times foods in each group were consumed per week was included at the end of each food group.

Maize meal was placed as the first food group, since it forms the staple food of the majority of the population. Participants should have found these questions easy to answer and so they would be encouraged to continue with the rest of the interview. Also, since maize meal is the staple food, it was important to collect as accurate information on its consumption as possible. It is also known that more accurate responses can be expected early in an interview before the participant loses interest or becomes bored[8]. The arrangement of foods into groups of similar foods or foods that are usually eaten together, rather than the traditional ‘food group’ classification was employed in order to aid the participants’ recall since most people associate food with meals or other foods[9,10].

Space was allowed at the end of each food group to add foods consumed but not listed in that section of the questionnaire. The computer food code and standard serving sizes were given for each item. Columns were provided for the amount of food consumed in household measures as well as in weight, and the frequency of consumption of each item in a “per day”, “days per week” “days per month” or seldom format was recorded.

The Administering of the Quantitative Food Frequency Questionnaire

The period covered by the QFFQ was the previous six months for children older than two years and one month for children aged between 12 and 23 months. The QFFQ was administered by fieldworkers, who had been specifically trained for this purpose (Appendix: Training Manual; Chapter 2 of this report). A food consumed less than once a month was marked as 'Seldom' and ignored for the analysis. The Province Coordinator was responsible for marking the food codes (and giving missing codes) and the conversion of the household measure amounts to the portion weight in grams. This was done to reduce the time needed to complete the QFFQ and to reduce computation errors. At the end of each food group, the respondent was asked the total number of times in a week foods in that group were consumed by the child. If this reply did not correspond with the frequencies already given, the frequencies were checked again with the respondent.

Validity

For the purpose of the survey, validation meant the comparison of data obtained from the QFFQ with those obtained from three separate 24-H-Rs (see Appendix: Training Manual). For the purpose of this exercise, each one of the three 24-H-Rs was completed in the same chosen household (HH) on a Monday, Wednesday and a Friday in a random order. It is important to note that the same fieldworker who completed the questionnaires in a given HH selected for the validation returned to that HH to complete the remaining two 24-H-Rs. The validation was done in every second HH in the chosen EA. The validation process was only done during the pilot phase of the survey (see also Chapter 2 of this report).

Repeatability

For the purposes of the survey, repeatability meant the ability of the field worker to obtain as accurate information as possible from the same interviewee one week apart (see Appendix: Training Manual). For this purpose, one HH was selected randomly by the coordinator in a manner similar to that for the quality control. In this selected HH, the same fieldworker had to return to complete the QFFQ and the anthropometric measurements a second time. This exercise was done in one HH in every EA in all Provinces. All fieldworkers were tested for repeatability during the course of the survey. The coordinator implemented this exercise without the prior knowledge of the fieldworker. During this exercise, a fresh QFFQ was completed without having access to the QFFQ questionnaire that had already been completed. Similarly, the fieldworker also had no access to the anthropometric measurements made previously.

Results

Validation and Reproducibility

For all validation variables, the QFFQ gave a higher intake than the 24-H-Rs (Table 6.1). With the exception of vitamin A, the Pearson correlation coefficient for nutrient intake data as obtained by the 24-H-R and the QFFQ were between 0,3 and 0,5 and were significant (Table 6.2). The Bland-Altman plots for the complete data (Table 6.3) and after excluding any outliers (Table 6.4), showed wide limits of agreement and proportional bias for all variables. From these plots, it appeared that the QFFQ gave a closer intake of nutrients to that of the 24-H-R at low nutrient intakes, but it overestimated nutrient intakes as the mean intake increased. Comparison of the quintile distributions showed a variable ability of the two methods to rank subjects into the same quintile (Table 6.5). In this regard, the highest percentage of subjects classified into the same quintile (37%) and adjacent quintiles (77%) was for thiamin. However, the protein and carbohydrate intake was classified into adjacent quintiles for 72% of the subjects. For the remainder of the nutrients, more than 60% of subjects were classified into the same or adjacent quintiles. The Energy Intake (EI) : Basal Metabolic Rate (BMR) was significantly higher for Kwazulu-Natal and Western Cape (Table 6.6), but for North West, Northern Province, Northern Cape and Eastern Cape, Gauteng and Mpumalanga the sample sizes were too small to draw any firm conclusions. Using the recommended EI : BMR ratio[11] of less than 1,2 as an indication of respondents underreporting nutrient intake (Table 6.7), 26,5% and 35% of the subjects could be classified as underreporting nutrient intake on the QFFQ and the 24-H-Rs respectively. By contrast, 43% of subjects had an EI : BMR ratio of greater than 1,8 with the QFFQ in comparison to 18% on the 24-H-R, thus confirming that respondents tended to over-report during the administration of the QFFQ.

In terms of repeatability of nutrient intake as obtained from the administration of the first and second QFFQ and with the exception of vitamin C and thiamin (the mean intake of which were almost the same on both administrations), the mean nutrient intake tended to be higher on the first than on the second administration of the QFFQ (Table 6.8). Although the percentage differences were small and variable (- 6.4 – 7.2%), the standard deviations were wide, indicating that differences for some subjects were very wide. However, none of the mean intake of nutrients differed significantly between the two administrations. The Pearson correlation coefficient for the intake of all nutrients (Table 6.9) was moderate to substantial (0.32 – 0.69), the strongest correlation being obtained for energy, carbohydrate and niacin. The Bland-Altman plots (Table 6.10) indicated that only the intake of energy and protein showed significant proportional bias. However, the limits of agreement were wide for all nutrients. The QFFQ was able to classify (Table 6.11) 49% or more of the subjects into the same and 79% or more of the subjects into adjacent quintiles on both administrations of the QFFQ.

In summary of the repeatability of nutrient intake as obtained by the first and second administration of the QFFQ, the analysis of the data indicated that there were no significant differences between the mean intake of nutrients. A moderate to substantial correlation was obtained for all nutrients with little evidence of proportional bias, and a very reasonable ability of the data to classify subjects similarly, in terms of nutrient intake, on both administrations. Therefore, the reproducibility of the data appears adequate. In line with similar studies in the literature, however, the relative validity may be considered less than adequate and, in a holistic perspective, may reflect the inadequacy of the currently available methodology for this purpose.

General

Breastfeeding

At the time of the interview only one out 10 children of all ages was still being breastfed at the national level (Table 6.12). However, one out of five children (19%) of the younger age group (1 – 3 years) was still being breastfed. The Northern Cape had the highest percentage of children (19%) that were still being breastfed at the time of the survey followed by the Free State (13%), Gauteng (12%), Northern Province (11%) and the Western Cape (11%), (Table 6.13). The highest percentage of children that were still being breastfed at the time of the interview lived on commercial farms (7%) and in informal urban areas (15%), (Table 6.14).

By far the majority (86%) of children of all ages had been breastfed as infants (Table 6.15) with the North West and Northern Province exceeding 90% of children (Table 6.16). This pattern held true irrespective of the area of residence (Table 6.17).

At the national level, 63% of children had been breastfed for more than a year (Table 6.18). However, a tendency for a lower percentage of younger children to be breastfed for less than one year was apparent (Table 6.18). The Northern Cape had the lowest percentage (39%) of children that had been breastfed for more than one year (Table 6.19) with six of the nine Provinces having percentages higher than the national average (63%). Only one out of two children in urban areas had been breastfed for more than one year (Table 6.20).

Use of infant formulae

Only 5% of all children were receiving infant formulae at the time of the interview (Table 6.21), a practice that was more frequent in children aged 1 – 3 years

(9%). Mpumalanga and the Western Province had the highest frequency of infant formulae use (9% and 7% respectively) (Table 6.22). Infant formulae use was, overall, equally common in urban and rural areas (Table 6.23). By far the most popular infant formula used was Nan (25%), followed by Nespray (11%) and the Lactogen series (10%) (Table 6.24).

Special diets

Less than 2% of children of all ages were following special diets at the time of the interview (Table 6.25). Of these 2% of children that were following special diets, the most frequently reported diets (Table 6.26) were for allergy (46%), weight reduction (21%), diabetes (1%) and various other (29%). There were no differences of note among Provinces or rural/urban residence (Table 6.26 - 6.27).

Eating away from home

One out of five children had eaten away from home during the week preceding the interview (Table 6.28) on a number of occasions, the number varying from once (22%) up to 7 times (1.5%), (Table 6.28). The most popular venue for eating out was crèche/school/pre-school/day-mother (58%) followed by family/friends or neighbours (39%) and take-away outlets (3%), (Table 6.29). The Province with the highest number of children eating out was the Western Cape (41%). No major urban/rural differences in this pattern were seen (Table 6.30).

Maize consumption

Ninety-three percent of children of all the survey age groups (Table 6.31) were consuming maize, with the highest frequency in North West (100%) and the lowest (76%) in the Western Cape (Table 6.32) as well as in informal urban areas (87%), (Table 6.33). At the national level, 89% of the respondents knew the brand name of maize they consumed (Table 6.34) and this was true irrespective of the area of residence (Table 6.35) or Province (Table 6.36), with the exception perhaps of the Eastern Cape (77% of the respondents knew). The most popular brands were Impala (18%), Ace (12%) and Iwisa (10%), (Table 6.37). Marked provincial differences were noted (Table 6.37).

Maize was purchased primarily (92%) at shops (Table 6.38) in all areas of residence, except on commercial farms, where maize was provided by the employer (Table 6.39). This was also the case in all Provinces (Table 6.40), except in the Free State and the Northern Cape, where maize was provided to 19% and 8% of the respondents by the employer respectively.

Maize which was purchased primarily in larger packages (10 – 80 kg) in almost all Provinces, with the exception of the Western Cape where smaller packages were preferred (Table 6.41), was stored mostly for up to 3 months (Table 6.42) and cooked for periods varying from 20 – 90 minutes (Table 6.43). The most commonly used facilities for cooking maize were an open fire (26%), or an electric (36%) or paraffin stove (26%), (Table 6.44). In tribal and rural areas of residence (Table 6.45), an open fire was by far the most commonly used facility (approximately 50% of respondents) as was the case for the Northern Province (Table 6.46). An open fire or a paraffin stove was also commonly used in almost all Provinces except the Western Cape (Table 6.46).

Eating patterns

Almost 90% of children of all age groups ate breakfast regularly (Table 6.47) irrespective of the area of residence (Table 6.48). A significant percentage of children (10 – 20%), however, ate breakfast only occasionally in Gauteng, KwaZulu/Natal, Mpumalanga the Northern Cape and the Northern Province (Table 6.49).

The greatest majority of children of all ages (87%) shared the family's main meal (Table 6.50) in all areas of residence (Table 6.51) with a notable exception in KwaZulu/Natal, Mpumalanga and the Northern Province, where 16 – 30% of children has specially bought and prepared food for them (Table 6.52).

The main meal pattern for children of all ages was primarily that of three daily meals, with (44%) or without (31%) in-between meals, (Table 6.53). This was the pattern, irrespective of the area of residence (Table 6.54), in all Provinces (Table 6.55). Notable exceptions were the North West, where almost one out of five children ate two daily meals with in-between meals, and Gauteng where 14% of children ate two daily meals without in-between meals (Table 6.55).

One third of children ate away from home (Table 6.56) at the households of other members of the family (36%), friends (18%), or at school (33%). A similar percentage of children in all areas of residence and in all Provinces ate at school (Tables 6.57 - 6.58).

Perceptions on fortified foods

Three-quarters of all respondents thought fortified foods were healthier (Table 6.59) in all areas of residence (Table 6.60) and all Provinces (Table 6.61). Of those who elaborated on their perception, fortified foods were thought to build the body, be good for energy, for growth and for health in general (Table 6.61). Nevertheless, almost 25% gave a “don’t know” response to this question.

Just under half of the respondents (46%) did buy fortified foods (Table 6.62) in all areas of residence (Table 6.63) and all Provinces (Table 6.64), and, indeed, 41% of respondents bought these foods frequently or occasionally (59%), (Tables 6.65 - 6.67). Thirty-eight percent of the respondents across the country indicated that they would buy fortified foods even if they were more expensive (Tables 6.68 – 6.70). However, one out of two respondents nationally cited a greater expense for not buying fortified foods (Tables 6.71 – 6.73) with the remainder of the respondents returning a “don’t know” response.

On probing, just over half (54%) of the respondents nationally volunteered the type of foods that, in their opinion, should be fortified (Table 6.74). The suggestions were equally forthcoming from all areas of residence (Table 6.75) and all Provinces (Table 6.76). Maize/porridge was the food proposed for fortification by the majority of respondents (32%), followed by vegetables (15%), bread (10%), rice (10%), samp (6%), meat / chicken (4%) and breakfast cereals (2%) (Table 6.77).

Iodised salt

The survey incorporated one question only on the use of iodised salt in the HH. Seventy-one percent of HHs used iodised salt with the remainder either not knowing whether they use it or not (18%) or using it without knowing (replied "No") (11%), (Table 6.78). This pattern was consistent for all areas of residence and all Provinces (Tables 6.79 – 6.80).

Flavoured salts

Just under half of the survey population (44%) used flavoured salts in the child's food (Table 6.81). These salts were used across the country (Table 6.82 - 6.83) and in wide variety (Table 6.83).

Dietary supplements

Just over one third of respondents nationally thought that dietary supplements would improve the health of the child, whereas almost an equal percentage (28%) did not think so and the remainder third (38%) did not know (Table 6.84). This perception was true across all areas of residence and Provinces (Tables 6.85 - 6.86). However, at the national level, only 5% of the respondents gave their child any dietary supplements at any one age (Table 6.87). Such supplements were given with the least frequency to children living in informal (86%) and formal (78%) urban areas (Table 6.88) in the Free State, Gauteng, Mpumalanga, and the North West Province (Table 6.89). The most commonly used dietary supplement cited by the respondents was "Multivitamins" (30%), followed by "Dyna Jets" (16%), "Vidaylin" (10%) and "Kiddievite" (7%), (Table 6.90).

Practically none of the respondents nationally knew what type of nutrients vitamins were (Table 6.91) and all of them confused them for macronutrients across all areas of residence and all Provinces (Tables 6.92 – 6.93). Interestingly, by far the majority of respondents (82%) thought that children and the elderly were the type of people who needed additional vitamins (Table 6.94 – 6.96).

Nutrient Intake

In the interpretation of the results presented in this chapter, it is important to realise some basic differences between the 24-H-R and the QFFQ methodology. The former imparts an impression of what an individual or groups of individuals ate the **day preceding** its administration, whereas the latter describes the frequency of consumption of foods and beverages **over a much longer period**. In the case of the present survey, this period covered the preceding 6 months for children older than 2 years of age, and one month for younger children. It is, therefore, to be expected that foods and beverages that were not eaten in the 24 hours preceding the interview may have in fact been eaten over the longer periods of coverage of the QFFQ. As such, and in agreement with what is described in the literature, nutrient intake as derived from the QFFQ was invariably higher than that obtained from the 24-H-R. This pattern was confirmed by the findings of the present survey and was consistent for the intake of all nutrients. In the presentation of the results, therefore, no comparisons have been made between the findings obtained from the 24-H-R and the QFFQ, unless a specific point needed to be highlighted. However, the findings from the two methodologies for selected nutrients have been graphically presented in this report for the convenience of the reader.

Macronutrient intake

Energy: On the basis of the QFFQ, analysed by Province and by age, the mean energy intake of children was higher than that obtained by the 24-H-R in all Provinces and for all age groups (Figure 6.1 – 6.3). Children, especially of the older age groups, in the Free State, Mpumalanga, Northern Cape, Northern Province and North West consistently had a lower mean energy intake than that recommended.

Figure 6.1 The mean energy intake of children aged 1 - 3 years by province and area of residence: South Africa 1999

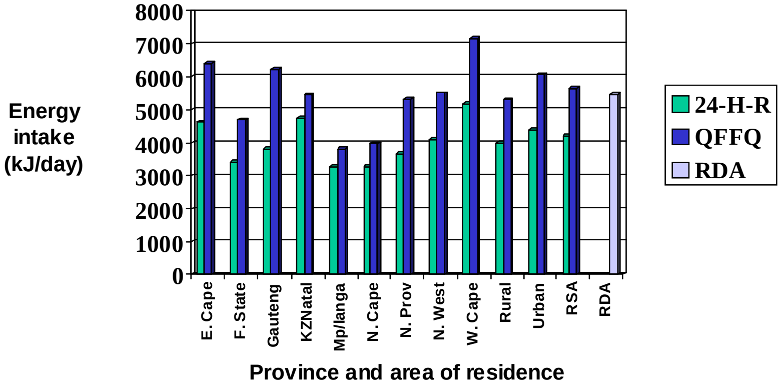


Figure 6.2 The mean energy intake of children aged 4 - 6 years by province and area of residence: South Africa 1999

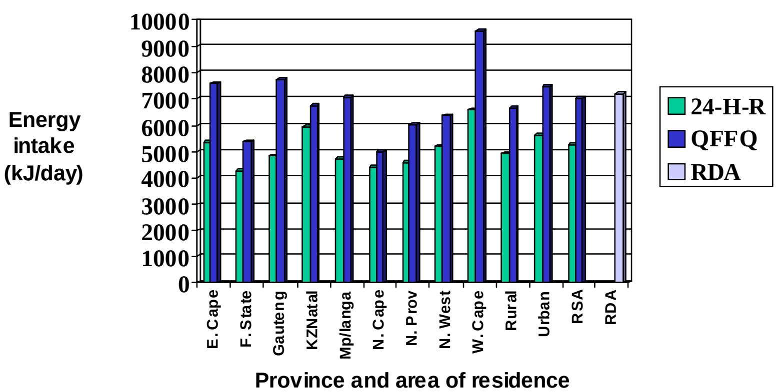
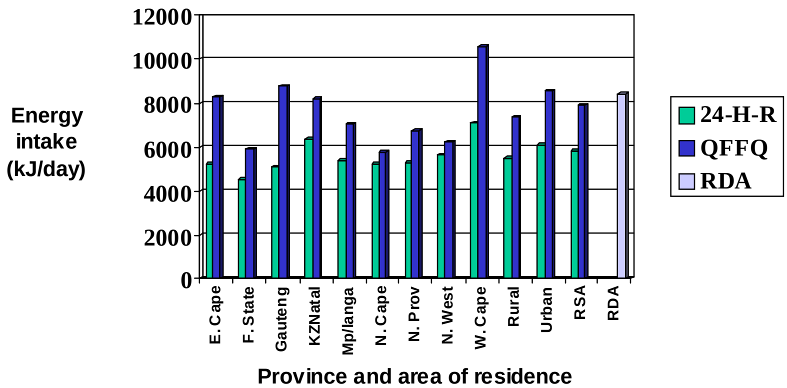


Figure 6.3 The mean energy intake of children aged 7 - 9 years by province and area of residence: South Africa 1999



Energy intake was the lowest in Mpumalanga for the 1 – 3 (3818 kJ) and the Northern Cape for the 4 – 6 (4990kJ) and 7 – 9 (5790kJ) year olds age groups. The three Provinces with the highest energy intake for all age groups were the Western Cape, Gauteng and KwaZulu/Natal. At the national level, one out of ten (13%) and one out of four (26%) children aged 1 –3 years respectively had an energy intake less than half and less than two-thirds of their daily energy needs (Table 6.97). Indeed, in the Northern Cape, Mpumalanga, Northern Province and the Free State, overall, one out of three children of all age groups had less than half of their daily energy needs. As such, these Provinces can be considered as being the worst affected. Children, especially of the older age groups, living in rural areas had a consistently and significantly lower energy intake than children living in urban areas (Figures 6.1 – 6.3; Table 6.97). No gender differences were seen.

Protein: The reverse was, however, the case for total protein intake (Figures 6.4 – 6.6; Table 6.98). For all age groups and Provinces the mean intake was higher than the RDA by both methods, although protein intake as obtained by the QFFQ was again higher than that obtained from the 24-H-R. The highest mean intake was found in the Western Cape and Gauteng, and the lowest in the Free State and Northern Cape. Urban children had a significantly greater mean intake than rural ones ($p < 0.0001$). The Northern Cape and the Free State had the greatest percentage of children with a protein intake of less than two thirds of the RDA. No gender differences were noted.

Figure 6.4 The mean protein intake of children aged 1 - 3 years by province and area of residence: South Africa 1999

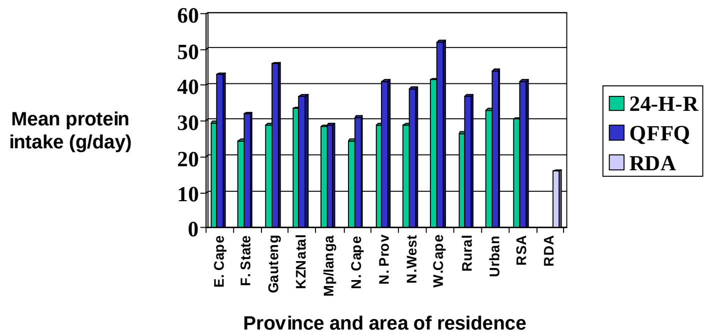


Figure 6.5 The mean protein intake of children aged 4 - 6 years by province and area of residence: South Africa 1999

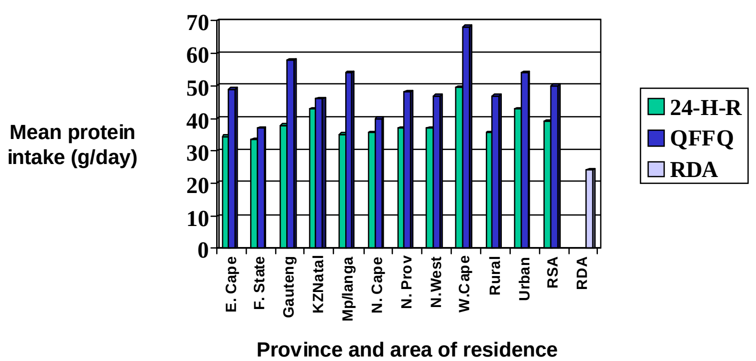
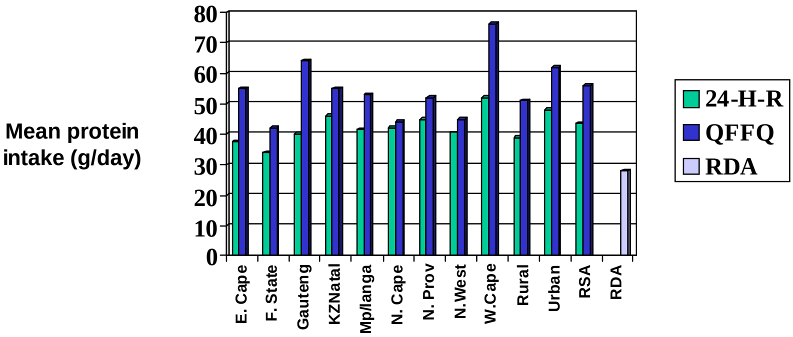


Figure 6.6 The mean protein intake of children aged 7 - 9 years by province and area of residence: South Africa 1999



Province and area of residence

Carbohydrate: Mean carbohydrate intake (Table 6.99) was the highest in the Western Cape, North West and in the Eastern Cape. The lowest mean intake was found in the Northern Cape and in the Free State. No significant differences were found with respect to rural-urban areas or gender. The highest mean sugar intake (Table 6.100) was found in the Western Cape, KwaZulu/Natal and Gauteng. The lowest mean intake was recorded in the Northern Province, Free State and Mpumalanga. Urban children had a significantly ($p < 0.0001$) greater mean intake than children living in rural areas. No gender differences were found.

Fat: The highest mean fat intake was found in the Western Cape and Gauteng (Figures 6.7 – 6.9; Table 6.101) and the lowest in the Free State, Northern Cape and in the Northern Province. Children living in urban areas had a significantly ($p < 0.001$) higher fat intake than those living in the rural areas, irrespective of gender.

Figure 6.7 The mean fat intake of children aged 1- 3 years by province and area of residence : South Africa 1999

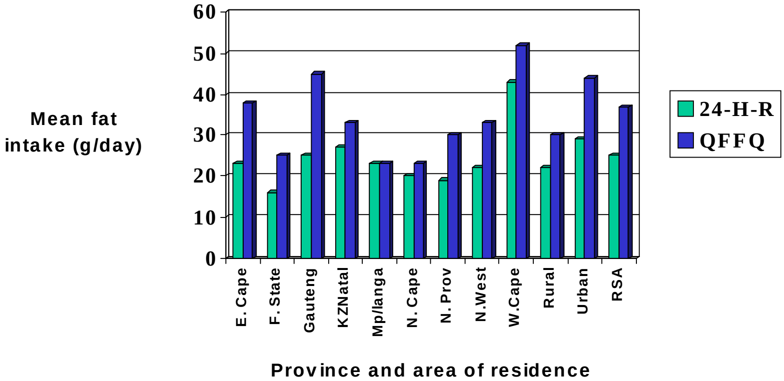


Figure 6.8 The mean fat intake of children aged 4 - 6 years by province and area of residence : South Africa 1999

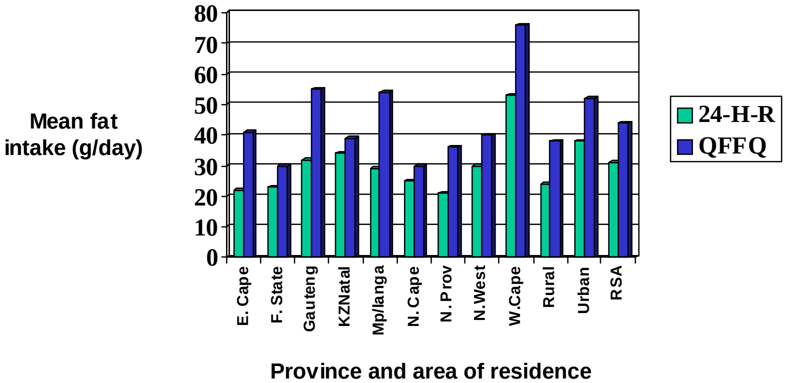
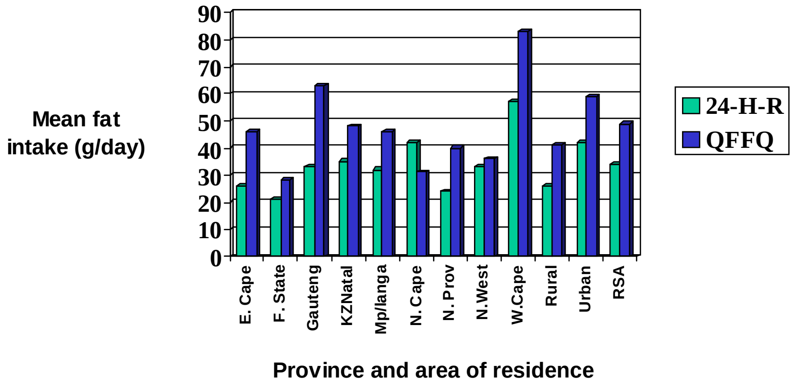


Figure 6.9 The mean fat intake of children aged 7 - 9 years by province and area of residence : South Africa 1999



Fibre: The highest mean fibre intake (Table 6.102) was found in KwaZulu/Natal, the Northern Province, the Western Cape and the Eastern Cape. The lowest intake was found in the Free State, Northern Cape and the North West Province. There was no significant difference in the intake of fibre between boys and girls nor between those living in urban or rural areas.

Distribution of energy: In terms of the energy distribution of the diet (Table 6.103), total fat, as a percentage of the total energy intake, was less than 30% in all Provinces with the exception of the Western Cape. On a similar basis, the protein contribution to energy intake was less than 15%, whereas that of carbohydrate was greater than 60% in all Provinces, with the exception of the Western Cape (55%) and Gauteng (58%). Sugar, as a percentage of energy intake, was highest in the Western Cape (15%) and Northern Cape (13%) and lowest in the Free State, Northern Province and Mpumalanga. The P:S ratio ranged from 0.9 in Gauteng and the Western Cape to 1.4 in the Eastern Cape and the Northern Province. Girls had a significantly higher percentage contribution to energy from fat ($p < 0.01$) and carbohydrate ($p < 0.01$) when compared with boys. Furthermore, children living in rural areas had a significantly greater (p< 0.0001) percentage of energy contribution from protein of plant origin, a pattern that tended to be also similar at the national level. The differences in the energy distribution between children living in urban as compared to those living in rural areas were statistically significant (p < 0.0001).

Micronutrient intake

Vitamins

Vitamin A: Only children living in the Northern Cape and the Free State had a vitamin A intake below that recommended (Figures 6.10 – 6.12; Table 6.104). It should, however, be noted that the values for the median were generally far lower than the mean intakes, indicating that the data is skewed and the standard deviation is very large in most instances. In this regard, it is important to note that, in general, approximately one out of two children of all ages and in all Provinces except in the Western Cape, had a vitamin A intake less that two-thirds of the RDA (Table 6.104).

Figure 6.10 The mean vitamin A intake of children aged 1 - 3 years by province and area of residence: South Africa 1999

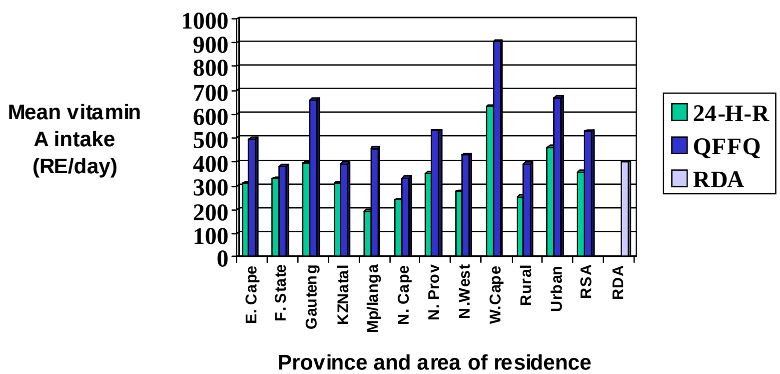


Figure 6.11 The mean vitamin A intake of children aged 4 - 6 years by province and area of residence: South Africa 1999

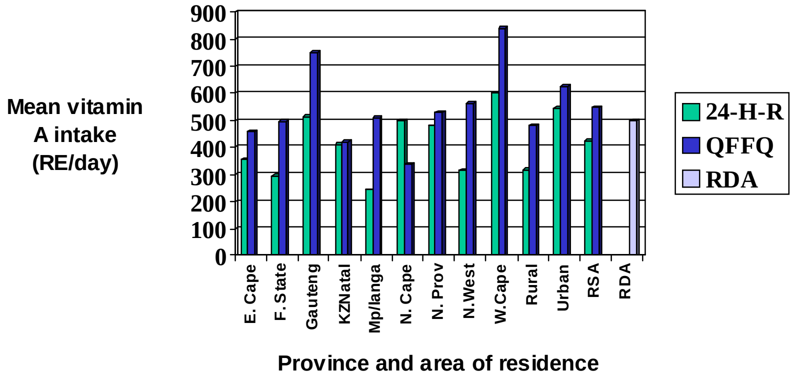
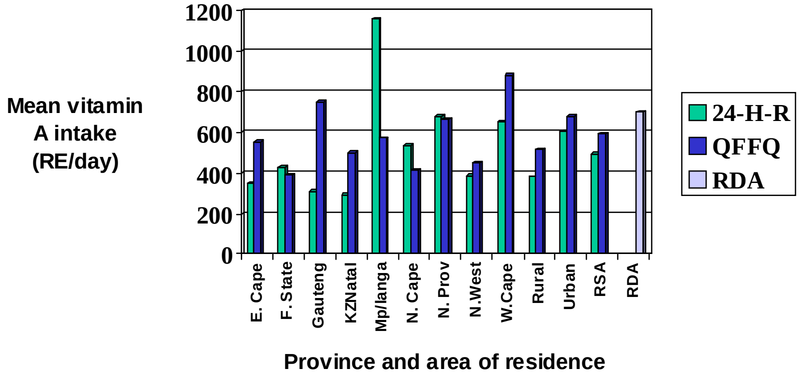


Figure 6.12 The mean vitamin A intake of children aged 7 - 9 years by province and area of residence: South Africa 1999



Vitamin D: Although the mean daily intake for vitamin D was far below the RDA for all children (Table 6.105), this finding needs to be interpreted cautiously because of the endogenous synthesis of vitamin D in the skin upon exposure to sunlight. A statistically significant ($p < 0.0002$) difference for vitamin D intake between urban and rural areas of residence was found only in children 1 – 3 years of age. No gender differences were noted.

Vitamin E: The mean intake for this vitamin was highest in the Western Cape and Eastern Cape, whereas the lowest intake was recorded in the Free State and in the Northern Cape (Table 6.106). A large percentage of children (19 – 68%) of all the age groups and in all Provinces had intakes less than two-thirds of the RDA. No urban-rural or gender differences were found except in children in the 1 – 3 year age group living in rural settings, who had a significantly ($p < 0.03$) lower vitamin E intake than children living in urban areas.

Vitamin C: The recommended intake for vitamin C was attained only by children living in urban areas, in the Eastern Cape, Gauteng, KwaZulu/Natal, and in the Western Cape (Figures 6.13 – 6.15; Table 6.107). Very low intakes were found in the Free State and the Northern Cape. At the national level, approximately one out of four children of all ages had an intake of less than half of that recommended. An urban-rural difference was only found in the 1 – 3 year old group and no gender differences were noted.

Figure 6.13 The mean vitamin C intake of children aged 1 - 3 years by province and area of residence: South Africa 1999

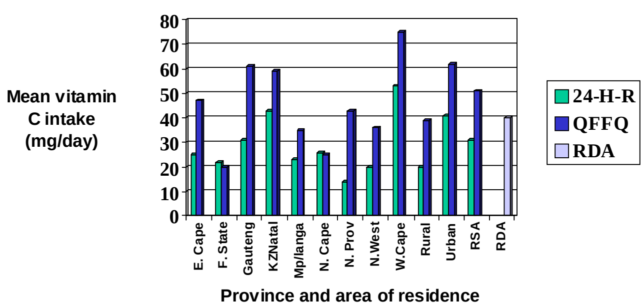


Figure 6.14 The mean vitamin C intake of children aged 4 - 6 years by province and area of residence: South Africa 1999

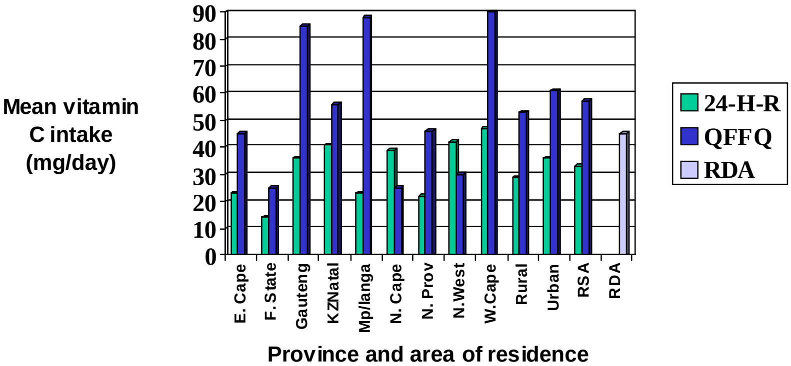
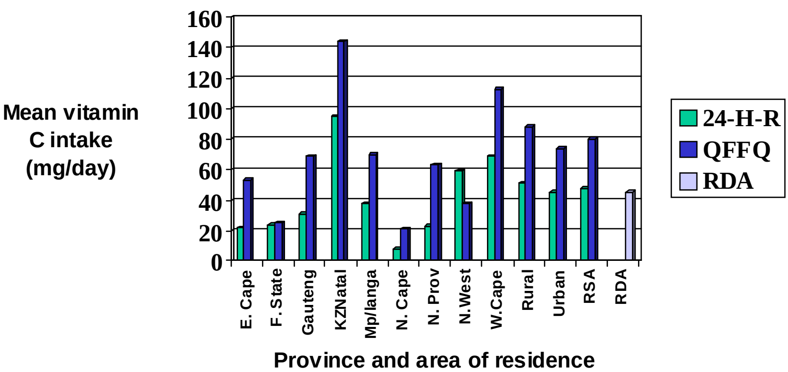


Figure 6.15 The mean vitamin C intake of children aged 7 - 9 years by province and area of residence: South Africa 1999



Thiamin: In most categories the mean intake for this nutrient exceeded the RDA. However, the median intakes were frequently far less than that recommended

(Table 6.108). The Northern Cape and the Free State had the highest percentage of children of all age groups with intakes of less than 50 % RDA. An urban-rural difference was only found in the 1 – 3 year old group and no significant gender differences were noted.

Riboflavin: The mean intake for this vitamin of children in all age group met the RDA (Table 6.109). Generally, median intakes were considerably less than the mean values. With the exception of the Western Cape, a significant percentage of children (14 - 46%) of all ages had intakes less than 50% of the RDA in various Provinces and an even larger percentage (19 – 62%) had a riboflavin intake of less that two-thirds of the RDA. Urban-rural differences in intake were significant ($p < 0.0001$) with children in the rural areas having a lower riboflavin intake.

Niacin: The mean and median intake for this nutrient was highest in the Western Cape and lowest in the Free State and the Northern Cape (Table 6.110). At the national level, nearly one out of four children had intakes of less than 50 % RDA. Significant ($p < 0.0001$) urban-rural differences were found.

Vitamin B_6: Children in the Free State and the Northern Cape had a mean and/or a median intake that was less than the RDA (Table 6.111). At the national level, approximately one out of ten children (8 - 10%) had an intake of less than 50 % RDA, and in almost twice as many children (14 – 20%) the intake was less than two-thirds of the RDA. Urban-rural differences were significant ($p < 0.0001$) in all age categories.

Vitamin B_{12}: Although the mean intake for this vitamin was greater than the RDA in almost all Provinces and in all age groups, the median intake was considerably lower (Table 6.112). With the exception of the Western Cape, 14 – 28% of children in all age groups in various Provinces had intakes of less than 50 % RDA with 10 – 34% of children having an intake less than two-thirds of the RDA.

Urban-rural differences in intake were significant (p < 0.0001 - < 0.004) in all age groups.

Folate: The mean folate intake was consistently and markedly lower than the RDA in all age groups in most Provinces (Table 6.113). With the exception of the Western Cape, approximately 11 – 61% of children of all ages had an intake of less than 50 % RDA and at the national level this was the case for approximately one out of four children. Urban-rural differences were significant (p< 0.07 – 0.0001) in all age groups.

Minerals and trace elements

Calcium: The mean calcium intake was less than half of that recommended in almost 95% of children in most Provinces except the Western Cape (Figures 6.16 – 6.18; Table 6.114). At the national level, one out of two and three out of four children had respectively an intake of less than half and less than two-thirds of the recommended intake (Table 6.114). Urban-rural differences in intake were significant (p < 0.001 – 0.0003) in all age groups.

Figure 6.16 The mean calcium intake of children aged 1 - 3 years by province and area of residence: South Africa 1999

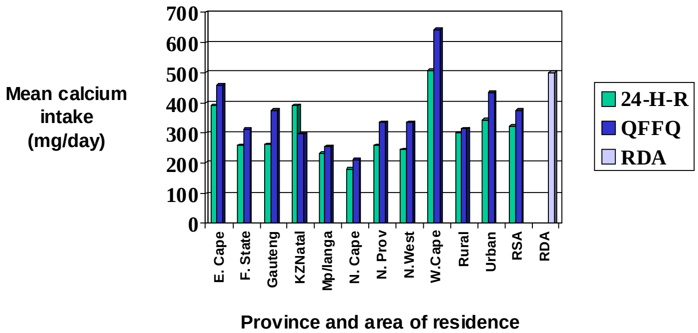


Figure 6.17 The mean calcium intake of children aged 4 - 6 years by province and area of residence: South Africa 1999

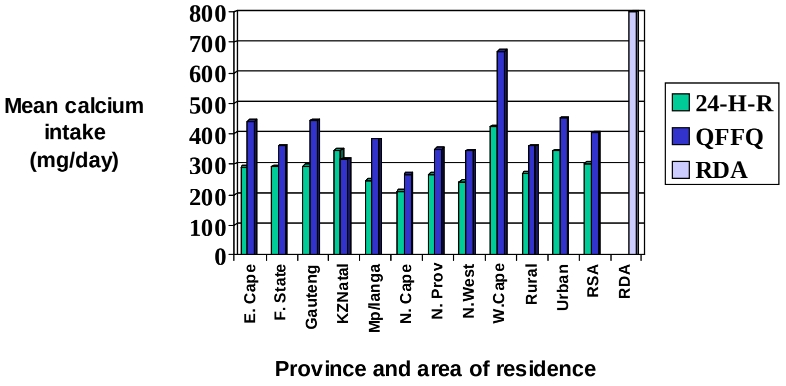
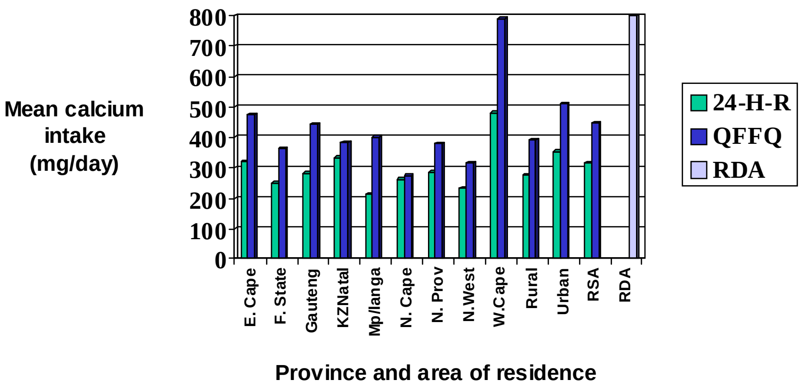


Figure 6.18 The mean calcium intake of children aged 7 - 9 years by province and area of residence: South Africa 1999



Phosphorus: The intake of this nutrient (Table 6.115) was mostly adequate in all age groups and close to the recommended intake. This is probably a reflection of the adequate protein intake reported on earlier in this section of the report.

Iron: The mean intake of iron was consistently low in all age groups and in the great majority of Provinces (Figures 6.19 – 6.21; Table 6.116). The lowest iron intake in all age groups was reported in the Free State and the Northern Cape. At the national level, 25 – 37% of children had an intake of less than half of the recommended level, whereas the corresponding percentage range for children having an iron intake of less than two-thirds of the RDA was 36 – 57% (Table 6.116). The gender differences in intake were unremarkable. However, children in all age groups living in urban areas had a significantly ($p < 0.05 – 0.001$) higher intake of iron than children living in rural areas.

Figure 6.19 The mean iron intake of children aged 1 - 3 years by province and area of residence: South Africa 1999

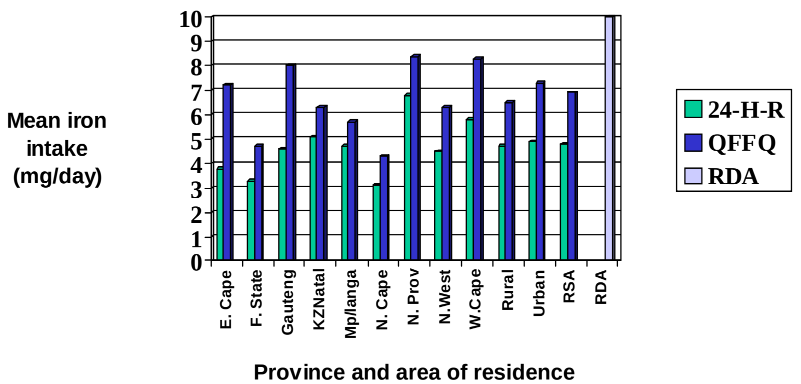


Figure 6.20 The mean iron intake of children aged 4 - 6 years by province and area of residence: South Africa 1999

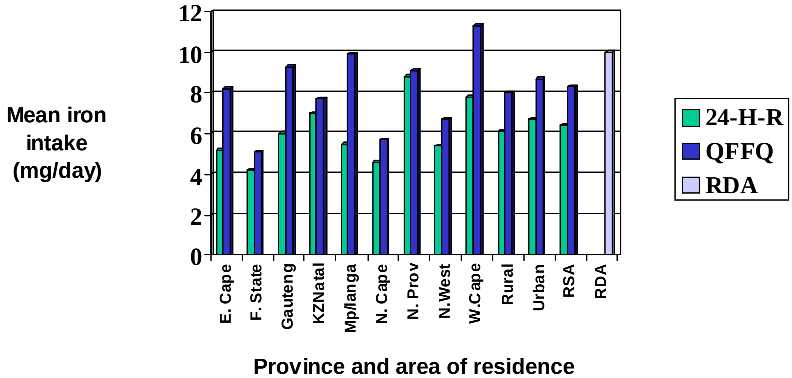
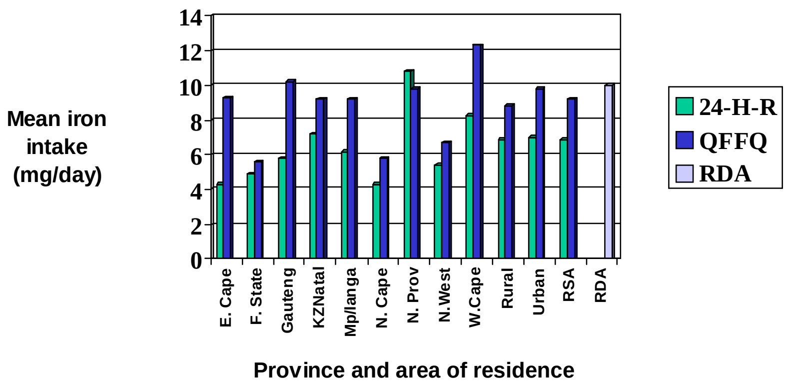


Figure 6.21 The mean iron intake of children aged 7 - 9 years by province and area of residence: South Africa 1999



Zinc: Similarly to iron, the mean intake of zinc was inadequate in all age groups and in all Provinces (Figures 6.22 – 6.24; Table 6.117). At the national level, 32 –

53% and 50 – 73% of children had respectively an intake of less that 50% and less than two-thirds of the RDA. Zinc intake was consistently and significantly ($p < 0.0001$) lower in children living in rural areas.

Figure 6.22 The mean zinc intake of children aged 1 - 3 years by province and area of residence: South Africa 1999

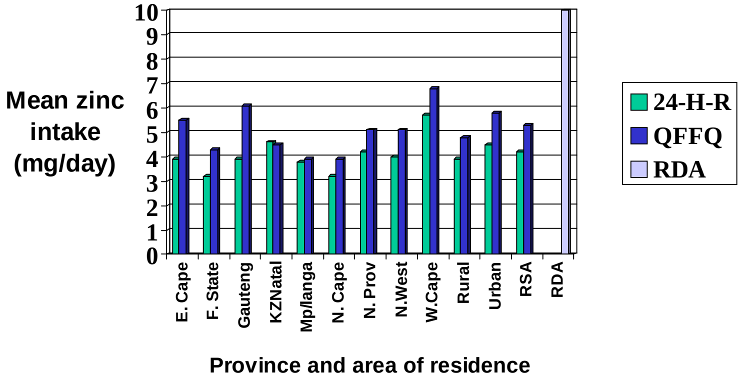


Figure 6.23 The mean zinc intake of children aged 4 - 6 years by province and area of residence: South Africa 1999

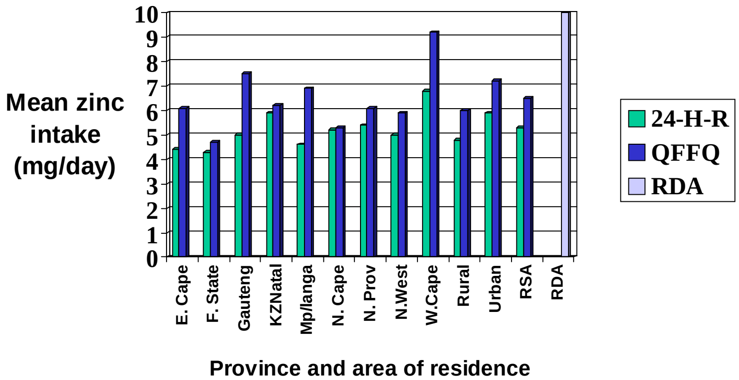
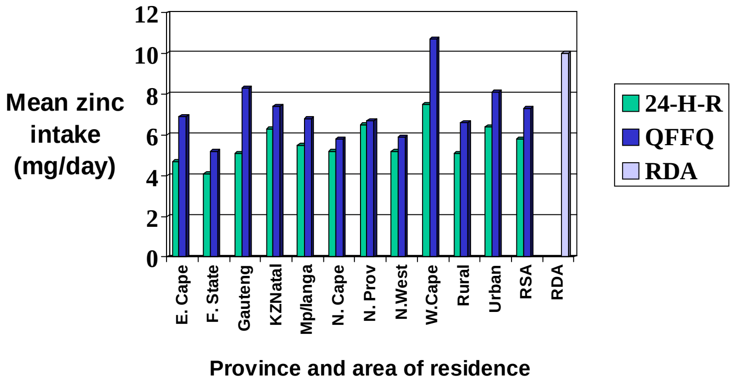


Figure 6.24 The mean zinc intake of children aged 7 - 9 years by province and area of residence: South Africa 1999



Selenium: Despite the limitations of the Food Composition Tables regarding the available data on this nutrient, it is nevertheless to be noted (Table 6.118) that the intake of selenium was consistently low in all age groups and in almost all Provinces. Indeed, approximately 60% of all children had an intake of less than 50% of the recommended level.

Magnesium: In line with the findings on protein and phosphorus intake, the intake of magnesium was also adequate in the great majority of children of all age groups (Table 6.119).

In summary on the nutrient intake of these children, it would appear that, in general, at least one out of three children have an intake of approximately less than half of the recommended level for a number of important nutrients. Indeed, a significant majority of children consumed a diet deficient in energy and of poor nutrient density to meet their micronutrient requirements (Figures 6.25 - 6.42).

Further, it is also to be noted that the analysis of the data by age revealed the expected increase in the mean intake of each nutrient from the age groups 1 - 3, to 4 - 6, to 7 – 9 years of age.

Figure 6.25 The percentage of children aged 1 - 3 years with an energy intake less than two-thirds of the RDA: South Africa 1999

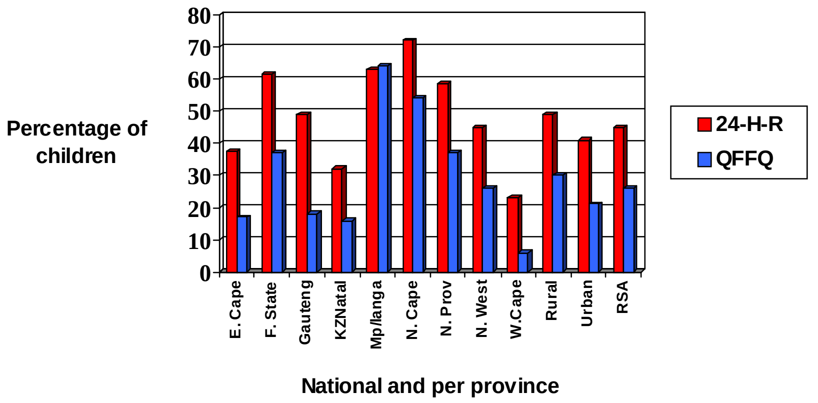


Figure 6.26 The percentage of children aged 4 - 6 years with an energy intake less than two-thirds of the RDA: South Africa 1999

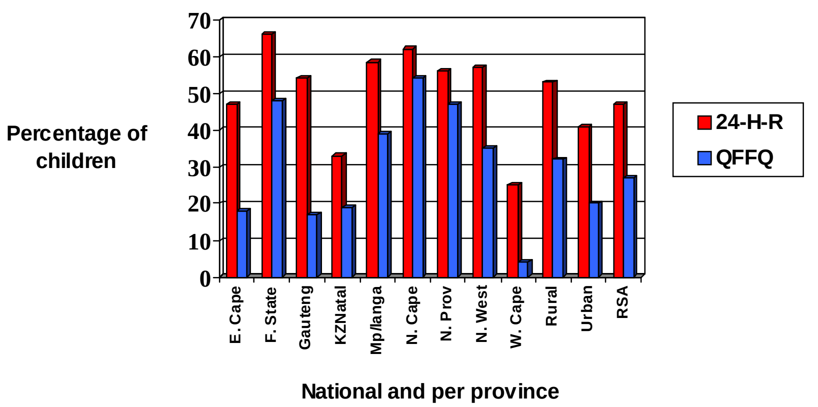


Figure 6.27 The percentage of children aged 7 - 9 years with an energy intake less than two-thirds of the RDA: South Africa 1999

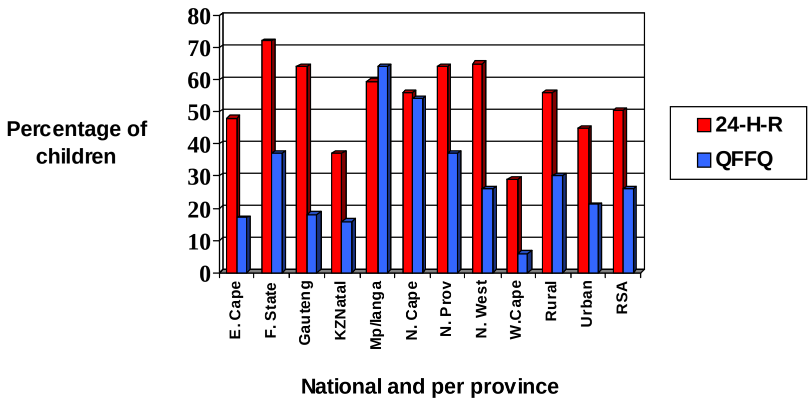


Figure 6.28 The percentage of children aged 1 - 3 years with a vitamin A intake less than two-thirds of the RDA: South Africa 1999

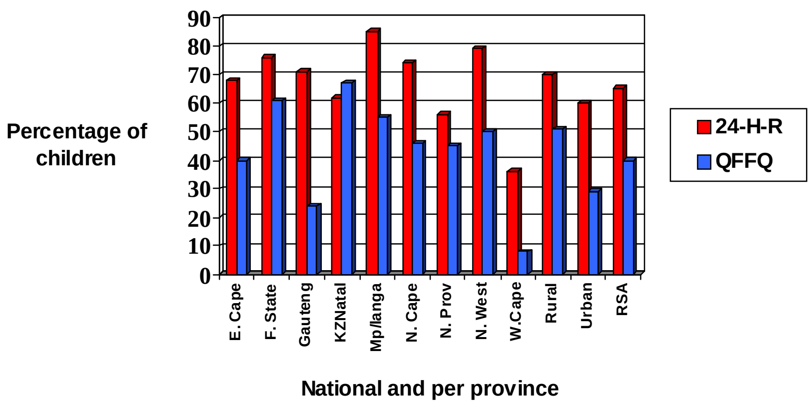


Figure 6.29 The percentage of children aged 4 - 6 years with a vitamin A intake less than two-thirds of the RDA: South Africa 1999

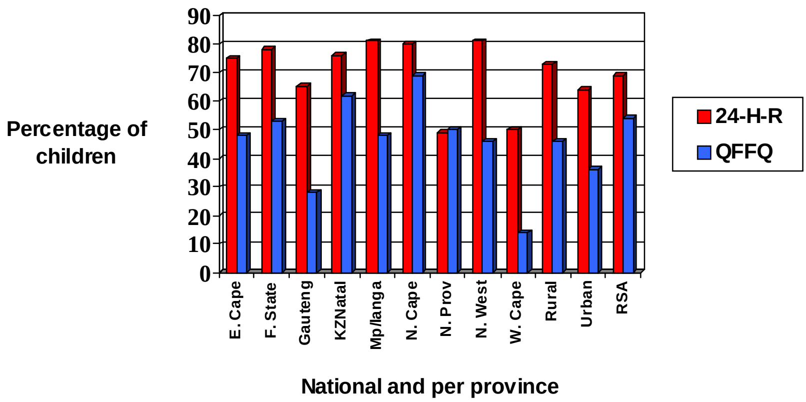


Figure 6.30 The percentage of children aged 7 - 9 years with a vitamin A intake less than two-thirds of the RDA: South Africa 1999

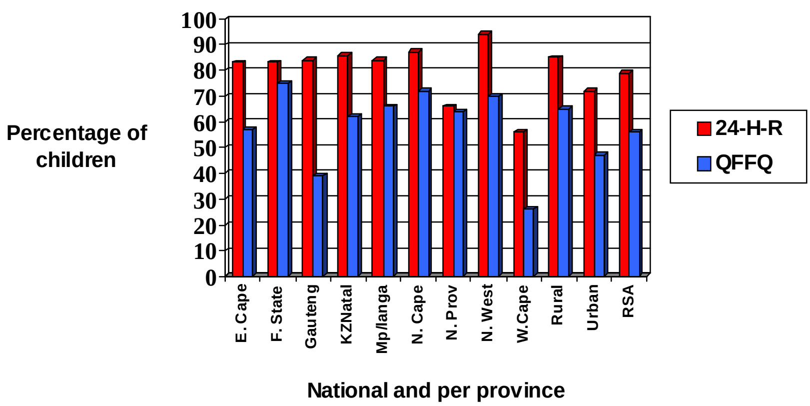


Figure 6.31 The percentage of children aged 1 - 3 years with a vitamin C intake less than two-thirds of the RDA: South Africa 1999

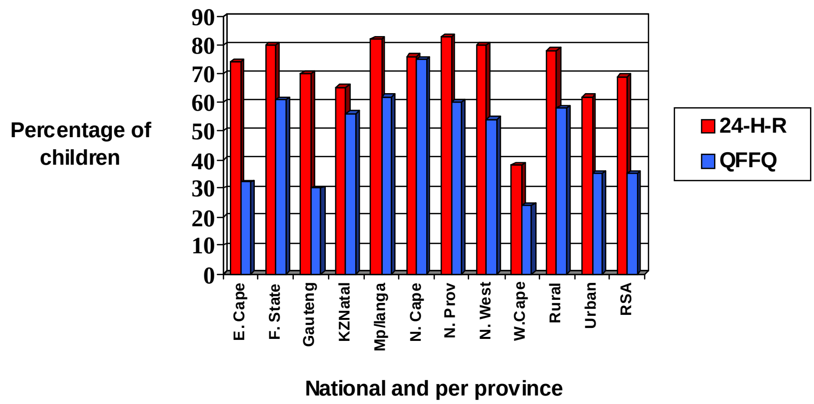


Figure 6.32 The percentage of children aged 4 - 6 years with a vitamin C intake less than two-thirds of the RDA: South Africa 1999

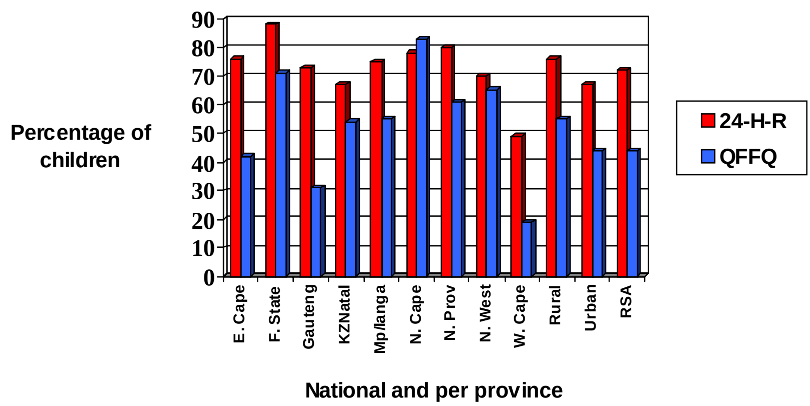


Figure 6.33 **The percentage of children aged 7 - 9 years with a vitamin C intake less than two-thirds of the RDA: South Africa 1999**

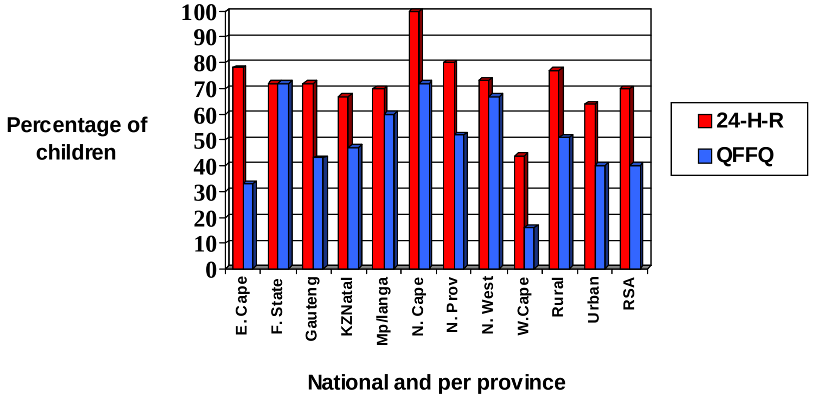


Figure 6.34 **The percentage of children aged 1 - 3 years with a calcium intake less than two-thirds of the RDA: South Africa 1999**

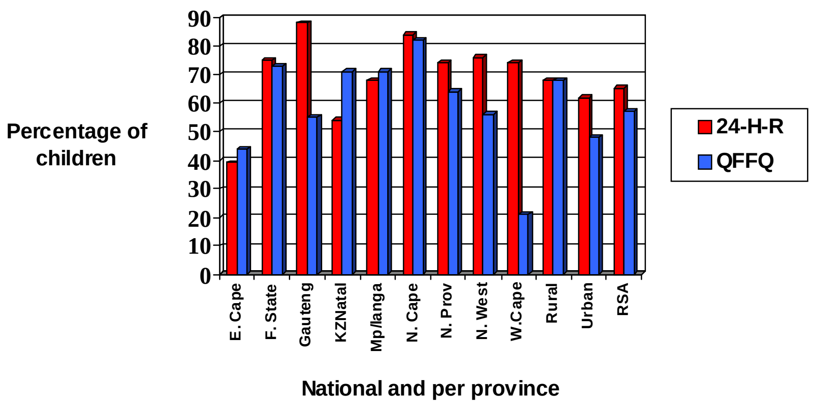


Figure 6.35 The percentage of children aged 4 - 6 years with an calcium intake less than two-thirds of the RDA: South Africa 1999

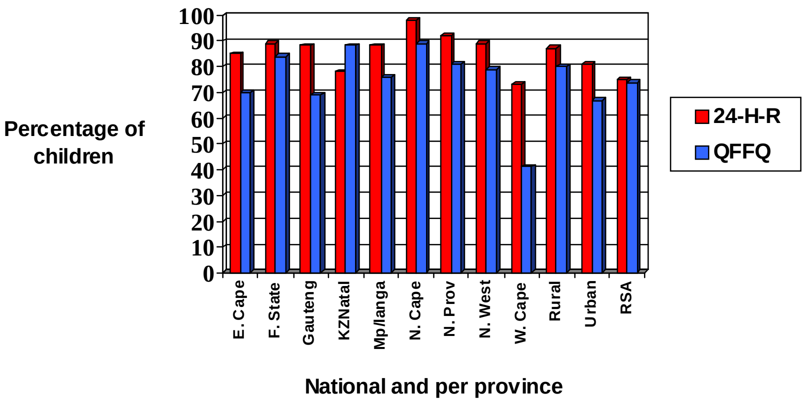


Figure 6.36 The percentage of children aged 7 - 9 years with a calcium intake less than two-thirds of the RDA: South Africa 1999

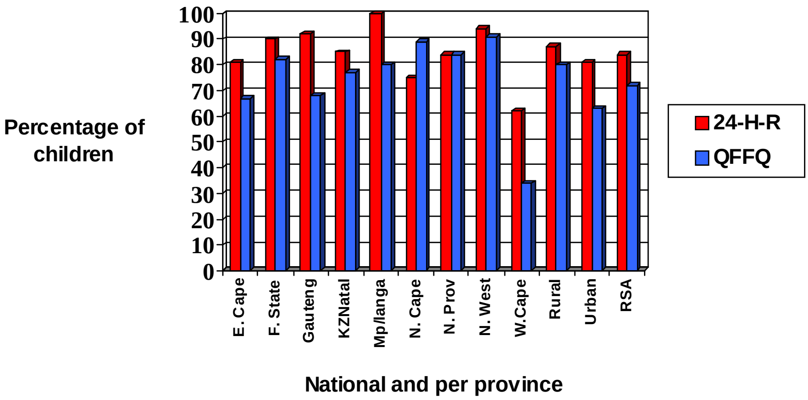


Figure 6.37 The percentage of children aged 1 - 3 years with an iron intake less than two-thirds of the RDA: South Africa 1999

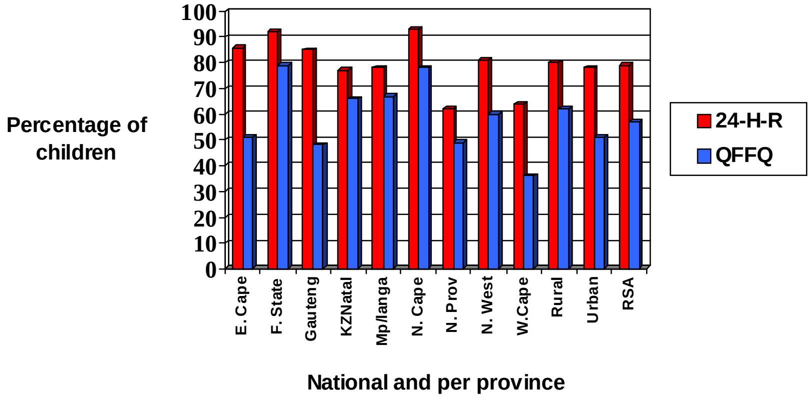


Figure 6.38 The percentage of children aged 4 - 6 years with an iron intake less than two-thirds of the RDA: South Africa 1999

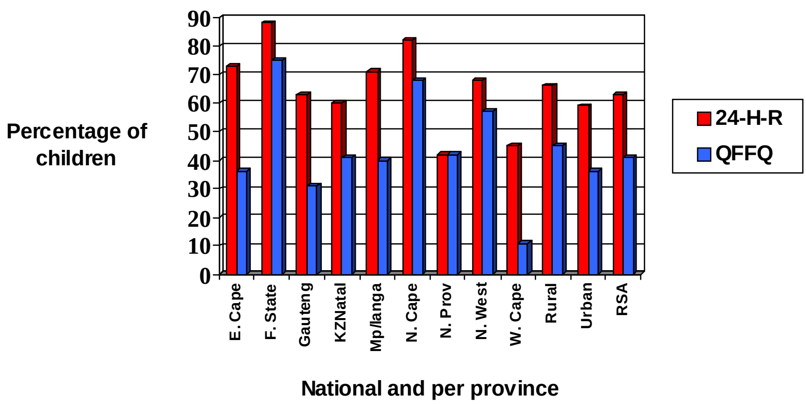


Figure 6.39 The percentage of children aged 7 - 9 years with an iron intake less than two-thirds of the RDA: South Africa 1999

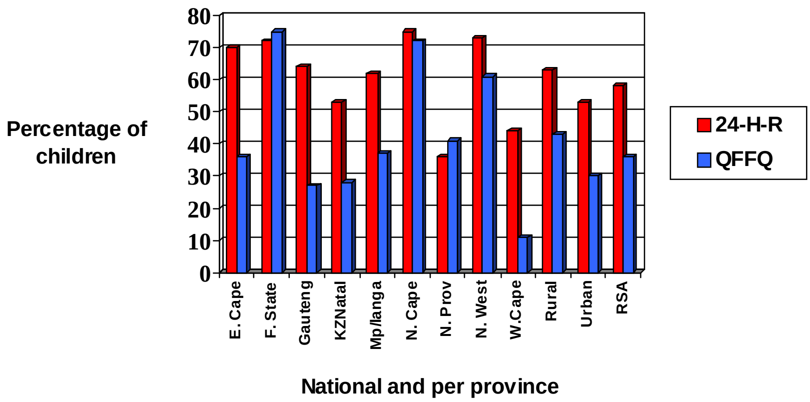


Figure 6.40 The percentage of children aged 1 - 3 years with a zinc intake less than two-thirds of the RDA: South Africa 1999

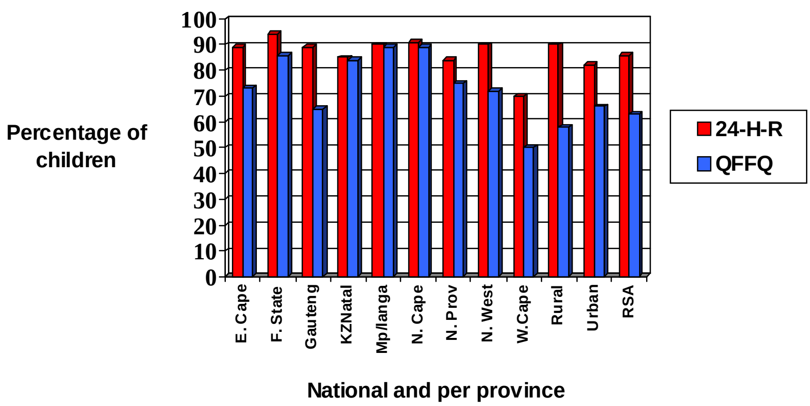


Figure 6.41 **The percentage of children aged 4 - 6 years with a zinc intake less than two-thirds of the RDA: South Africa 1999**

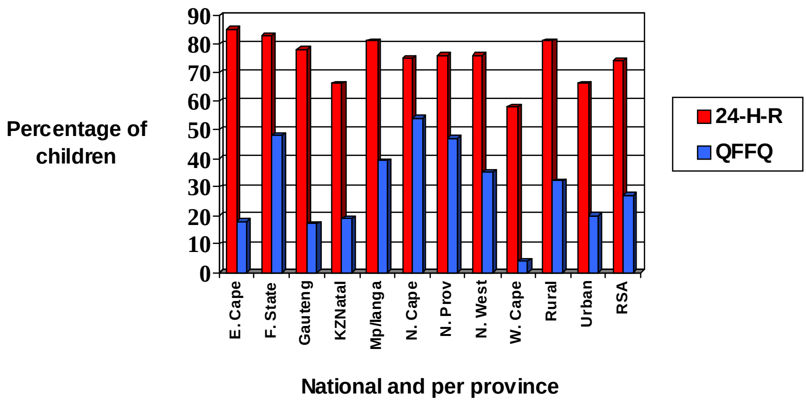
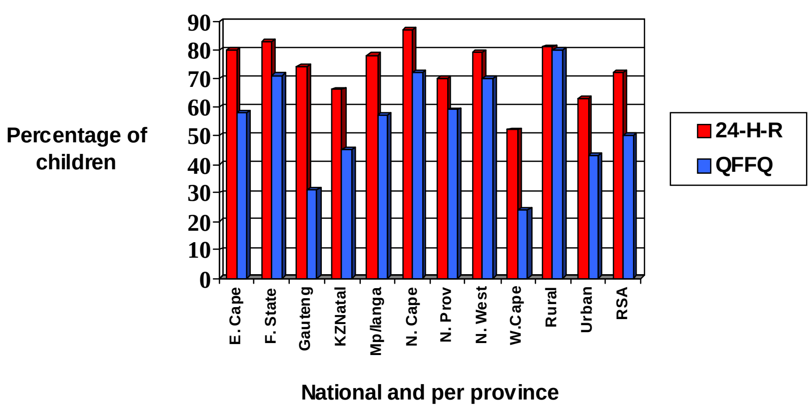


Figure 6.42 **The percentage of children aged 7 - 9 years with a zinc intake less than two-thirds of the RDA: South Africa 1999**



For South African children as a whole, the intake of the following nutrients was below two-thirds of the RDAs:

- Energy
- Calcium
- Iron
- Zinc
- Selenium
- Vitamin A
- Vitamin D
- Vitamin C
- Vitamin E
- Riboflavin
- Niacin
- Vitamin B_6

It is also important to note that the findings on the nutrient intake as obtained by the QFFQ are largely very supportive of those obtained by the 24-H-R, although, as expected, nutrient intake in absolute values is higher when obtained by the former than the latter methodology.

Foods Children Eat

At the national level (Table 6.120), the five most commonly eaten foods included maize, white sugar, chicken, vegetables (potato/sweet potato) and white rice. This pattern, however, varied considerably among the Provinces, and for the sake of convenience and ease of reference, the frequency of items consumed in each Province are presented in separate tables (Tables 6.121 – 6.129). It is important to note that the frequency with which children ate the food items listed has been ranked according to the number of children eating a particular food, as was the case with the presentation format of the findings of the 24-H-R. In this regard, however, it is equally important to note that, when this frequency was ranked according to the average number of times a particular food item was eaten by children per day, then the five most commonly consumed foods as obtained by the QFFQ were almost identical to those identified by the 24-H-R. The findings of the present survey, therefore, obtained by two different methodologies were mutually and largely supportive of each other.

Nutrient Intake and Anthropometric Status

Energy intake was significantly ($p < 0.0001$) correlated with H/A (Pearson's correlation, $r = 0.14$) and W/A ($r = 0.15$) in all age groups in five and four of the nine Provinces respectively, and in children living in rural and urban areas, formal urban (H/A and W/H), tribal areas (H/A and W/H) as well as on commercial farms (W/A). A correlation (Spearman's) of the same frequency, magnitude and significance was also found specifically with milk and dairy product consumption as well as with the consumption of foods of animal origin (meat, fish, eggs, milk and dairy products) at the national level and for all age groups, with H/A ($p< 0.05$) in five Provinces, W/A ($p < 0.05$) in seven Provinces, H/A in rural areas, H/A and W/A in urban and formal urban areas as well as commercial farms, and with H/A in tribal areas.

Discussion

On the basis of the QFFQ, at least one out of three children have an intake of approximately less than half of the recommended level for a number of important nutrients. Indeed, a significant majority of children consumed a diet deficient in energy and a number of micronutrients including calcium, iron, zinc, selenium, vitamin A, vitamin D, vitamin C, vitamin E, riboflavin, niacin and vitamin $B_{6.}$ These findings are largely very supportive of those obtained by the 24-H-R, although, as expected, nutrient intake, in absolute values, is higher when obtained by the QFFQ as compared with the 24-H-R methodology. At the national level, the five most commonly consumed foods included maize, white sugar, tea, whole milk, bread and hard margarine/cooking fat.

The differences between mean reported intakes derived from the repeated 24-H-RQ (the reference method) and the QFFQ (of the test method) express the average tendency to over- or underestimate nutrient intakes relative to the reference method at group level[12]. It is evident that, in the present survey, the QFFQ gave higher mean intakes for energy and for all nutrients tested than the 24-H-RQ. With exception of vitamin A, all differences in mean reported intakes were statistically significant. It is also important to note that the percentage difference between the means for all variables exceeded the 10% level, which is the generally accepted satisfactory percentage difference for relative validity[13,14]. Similar findings of higher intakes being reported from a QFFQ in comparison with dietary records have been reported from a number of studies in adult populations [13,15,16]. In the case of children, Bellu et al[17] reported higher intakes from a QFFQ in comparison with a single 24-H-RQ for energy for both male and female subjects and for carbohydrate and fat for males. By contrast, a similar QFFQ tested against seven day weighed records in an adult African sample[7] gave higher intakes on the QFFQ than on the weighed records for carbohydrate and vitamin C but lower intakes for energy, protein, fat, calcium, iron and vitamin A. The percentage difference ranged from 1% – 7% for the intake of energy and vitamin C respectively, which is considerably lower than the range obtained in the present study (18% - 41%). In this regard, the different populations investigated in the two studies together with other methodological differences should be borne in mind. Nevertheless and despite the intensive training given to all fieldworkers, the higher intake of nutrients in the present survey may have been due to a number of reasons including an overestimation of the frequency of the food items consumed by the interviewee, the lengthy questionnaire or an overestimation of the portion sizes. Furthermore, it should also be borne in mind that the 24-H-RQ may have underestimated the intake of nutrients. In this regard, it is generally well accepted that the 24-H-RQ does tend to underestimate the intake of nutrients in comparison with the QFFQ[18]. More specifically in children, a validation study comparing the intake of nutrients as obtained by the 24-H-RQ with that from weighed food records reported the 24-H-RQ to have given consistently lower mean intakes than the weighed food record methodology[19].

Despite the inherent and accepted disadvantages of the correlation coefficient, it remains one of the most frequently used statistical measures of agreement for relative validation data. A statistically significant moderate to strong correlation coefficient[20] would be considered acceptable for the purpose of relative validity. In the present survey, Pearson correlation coefficients varied between 0,06 (vitamin A) and 0,5 (vitamin C), and, with the exception of vitamin A, all correlation coefficients were significant. Coates and Monteihl[21] summarised the range of correlation coefficients obtained in QFFQ validation studies in minority populations to range from 0.4 to 0.7. Furthermore, in a study using a seven-day weighed food records as the reference standard in an adult African population[7], correlation coefficients of between 0.2 for iron and 0,6 for vitamin C were reported. In unison with the findings of the present survey, the strongest correlation coefficients were obtained for energy, fat and vitamin C, while the weakest such coefficients were obtained for vitamin A, iron and calcium. When considering correlation coefficients as indicators of relative validity, the level of a statistically significant correlation, which is indicative of “satisfactory” agreement between dietary methods, is generally accepted to range from 0.4 to 0.7[22]. However, the current scientific literature provides no clear and agreed upon cut-off point above which a test methodology can be said to be relatively valid. This may be because validation studies vary so widely in methodologies, sample sizes, population characteristics as well as test and reference methods that it is not possible to derive a standard acceptable level of correlation. Although it is generally accepted that the stronger the correlation coefficient, the better the agreement between methods, a recent study[7] reported that few studies in the literature achieved correlation coefficients of higher than 0.7, which would have been indicative of substantial to strong agreement[23,24]. In this regard, the Euronut SENECA investigators[25] concluded that the range of coefficients reported in their study (0.18 – 0.78) were satisfactory, while other investigators[26] have concluded that correlation coefficients in the range of 0.27 to 0.41 were too low to warrant the use of data obtained by a QFFQ. On the other hand, Margetts *et al*.[27] have concluded that the use of such data was possible with correlation coefficients in the order of 0.34 – 0.7. On the basis of this latter[27] and other such studies, which have set similar acceptable ranges for correlation coefficients[28], the QFFQ used in the present survey would appear to have provided satisfactory correlation coefficients for energy and for all nutrients tested except for vitamin A.

The Bland-Altman plot technique is a fairly recent method for analysing validation data and, hence, there are few studies with which to compare the results of the present survey. The usefulness of the Bland-Altman technique is that it is able to show the presence of constant and proportional bias in a sample, that is, it examines whether agreement between the two methods is consistent over a range of intakes[29]. A significant positive correlation between the average nutrient intake as obtained by the QFFQ and the 24 H-RQ as well as the difference between such intakes as obtained by the two questionnaires, indicated that, as the intake of nutrients increases, the nutrient intake obtained from QFFQ was proportionally higher than that obtained by the 24-H-R. This occurred for the intake of all nutrients tested. In addition, the wide limits of agreement suggested poor agreement between the two methods. Thompson and Margetts[29] using Bland-Altman plots, showed that, for male subjects at a low energy intake, the food frequency questionnaire gave lower estimates for energy, but at higher intakes, it gave higher estimates than the dietary record. However, other studies[30] have not confirmed these findings, in fact they have reported in the opposite. In another study[7], although limits of agreement on nutrient intake were wide, there did not appear to be a tendency towards proportional bias, rather the largest differences seemed to be in the mid-range of intakes.

By contrast to the above studies, the Bland-Altman plots of the present survey would appear to indicate the presence of some proportional bias, in the sense that the intake of nutrients as obtained by the QFFQ were higher than those obtained by the 24-H-RQ, at all levels of intakes. However, at low average nutrient intake, these differences were smaller and increased as the average nutrient intake increased. The importance of this finding in the present survey is that, since the aim of the survey was to identify those at risk with a low intake of nutrients, it is, indeed, comforting that the QFFQ appears to have performed better at low rather than at high intakes. Nevertheless, it should be clearly borne in mind that the findings of the studies referred to[7,29,30] cannot be directly, or meaningfully, be compared to those of the present survey, because, apart from the major differences in the type of populations studied, the nutrient intake as obtained by both the QFFQ and the 24-H-RQ in the present survey increased significantly and consistently with age, a finding that makes the significance of the apparent proportional bias even more difficult to interpret.

The purpose of the comparison of the quintile distributions of nutrient intake as obtained by the QFFQ and the 24-H-RQ was to determine the proportion of subjects classified into similar quintiles by the two methods employed in the present survey[29]. In general, good agreement has been shown for a high proportion of subjects classified into the same or adjacent quintiles by both methods. Chance alone accounts for 20% and 72% of subjects being classified within the same and adjacent quintiles respectively[31]. With a range of 28% to 37% of subjects classified into the same quintile in the present survey, only a small proportion (8% to 7% respectively) would have been classified into the same or adjacent quintiles, if such a classification due to chance alone could be excluded. Ranges of 29% to 66% and 73% to 98% for such classifications have been reported[7] in an adult African population in a study employing different methodologies, which makes any comparisons rather inappropriate. Nevertheless, for energy, the percentage of subjects classified into the same quintile (32%) and adjacent quintiles (69%) in the present survey are similar to those found in other studies[7,32]. For instance, the percentage of subjects classified into the same quintile vary from 25% for protein[32] to 68% for vitamin

C[33], while classification within adjacent quintiles varies from 61% for total carbohydrate[34] to 95% for vitamin C[7].

In terms of relative validity of the QFFQ as used in this survey, it has been suggested[35] that validity of a QFFQ in relation to the 24-H-RQ would be acceptable if:

- There were significant correlation coefficients between the two methodologies
- There were no significant differences between the means of nutrient intakes
- There was no proportional bias, indicated by a non-significant correlation in the Bland-Altman plot, and,
- There was a high percentage of subjects classified within the same and adjacent quintiles by both methodologies.

The QFFQ used in the present survey fully met the first criterion (significant correlation) indicating good relative validity at the group level, and only partly met the remaining three criteria bearing in mind the limitations and difficulties that have already been discussed regarding the interpretation of such data. It is, therefore, strongly recommended that, in interpreting the results of the main survey, medians, inter-quintile ranges and frequency distributions should be used, rather than mean nutrient intake values, which might be inflated by extreme reported intakes. Further in this regard, the quintile distributions should be considered as estimates, and the proportion of children identified as being at risk of a deficient intake should be considered as under-estimations of risk. It is also important to note that the findings of the present survey cannot be applied to individuals or small groups within the population. Thus, conclusions regarding intakes of small Provinces and age group sub-samples should be made with great caution.

Comparison of the results on reproducibility of the present survey with the literature is rather difficult because of the many methodological and analytical differences among reported studies. This is particularly true for the present survey, since no reports for a similar population group could be found in the literature and the one-week interval between the two administrations of the QFFQ is considerably shorter (because of financial considerations) than that in other reported studies. Nevertheless, it should be noted that there was very little difference between the two administrations of the QFFQ in the mean reported intakes of all the variables tested. With the exceptions of carbohydrate, calcium and vitamin C, the first administration gave higher intakes than the second administration. None of the differences, however, were statistically significant. This finding is similar to that reported by several studies[36-39], but differs from the findings of other studies that reported the opposite trend[7,40,41]. Within the previously commented upon limitations on the use of correlation coefficients, the range of coefficients (0.3 - 0.7) obtained in the present survey for reproducibility, is lower than that reported by Forsythe et al[42] (0.69 - 0.97) in a study which also had a one week time interval between administrations, but higher than those obtained by MacIntyre[7] (0.15 - 0.4) which used a similar QFFQ with a 4 -12 week time interval between administrations. Furthermore and in contrast to the findings on the relative validation, the Bland-Altman analysis on reproducibility showed proportional bias only for energy, protein and carbohydrate. In terms of quintile distributions, more than 49% of subjects in the present survey were classified into the same quintile and over 79% into adjacent quintiles by the two administrations for all variables tested. In comparison to the results of other studies[7,43], the present survey showed a higher level of agreement within the same quintile, but a similar level of agreement within the same and adjacent quintiles. The apparently good reproducibility found in the present survey may be due to the short interval between the two administrations of the QFFQ. Such reported intervals commonly vary from two[44] or three months[36,41] to 12 months or longer[37,45]. It is also generally accepted that an interval between administrations as short as one week cannot give a meaningful measure of reproducibility[46]. Although the short period between administrations ensures that food intake patterns did not change, it makes the likelihood of interviewees remembering previous answers, or making the same errors, stronger. With too short a time between administrations, part of the measurement error may be correlated, giving spuriously high correlation coefficients. Although a short time interval is not desirable for reproducibility studies, the size of the survey sample, time restrictions and the cost considerations in the present survey made a longer inter-administration period impractical. However, since reproducibility is a part of the relative validity of a measurement instrument[47], the apparently good reproducibility of the QFFQ questionnaire in the present may be interpreted as strengthening its relative validity. On the other hand, It must be borne in mind that an instrument may be highly reproducible but not valid[20,47]. In the present survey, for example, if the format of the QFFQ favoured overestimation, it is likely that it overestimated intakes on both the first and second administrations.

The ratio of energy intake to basal metabolic rate (EI:BMR) is a more objective means of assessing whether a reported energy intake is reasonable in terms of energy requirements[11]. If the EI:BMR falls below a given cut-off value, the reported intake may be suspected of being an underestimation. A low EI:BMR ratio suggests that the reported energy intake is incompatible with health and normal body weight[48]. The ratios, reported in the literature, below which energy intakes have been considered incompatible with health and normal body weight, vary from 1.1[49] to 1.54[50]. Bingham[11] has suggest that an EI:BMR ratio of 1.2 should be taken as the lowest reasonable ratio, below which reported energy intake may represent an underestimation. The said ratios, however, have been proposed for adult populations under the assumption of energy balance[48]. No studies using EI:BMR in children could be found in the literature. The closest sample to that of the present survey used a cut-off limit for EI:BMR of 1.2 in a sample of Nigerian females aged between 11 and 17 years[51]. In addition to the problem of the choice of an appropriate cut-off ratio as an indication of underreporting, concern has been also expressed about the validity of the Schofield equations[52] for the estimation of BMR[51,53]. In the light of the above, the proposed cut-off ratio of 1.2 as suggested in the literature[11,51] and used in the present survey must be considered as an arbitrary value. Rather than looking at the absolute percentages of subjects with EI:BMR ratios below 1.2, it would be more useful to compare the frequency distributions obtained for the 24-H-R and the QFFQ. In this regard, two points are clear from the comparison of the EI:BMR ratios in the present survey (Tables 6.6 and 6.7). First the ratio for the QFFQ (1.98) is significantly higher than that of the 24-H-R (1.4). Second, 43% of subjects had an EI:BMR ratio greater than 1.8 for the QFFQ compared to 18% for the 24-H-R. These findings suggest that the QFFQ was more likely to overestimate energy intake than the 24-H-R. Interestingly, the percentage of children with EI:BMR ratios less than 1.2 did not differ significantly between the QFFQ (26.5%) and the 24-H-R (35%). These findings, therefore, strengthen the concept that, irrespective of the differences in the nutrient intake obtained by the QFFQ and the 24-H-R, the two methodologies are largely supportive of each other, and that the intake of nutrients presented in this report is a fair and reasonable reflection of what South African children eat.

The findings of the present survey indicate that, although almost nine out of ten children had been breastfed and one out of five children in the age group 1 – 3 years in the country were still being breastfed at the time of the survey, the apparent tendency for fewer younger children to have been breastfed for less than one year is of concern. In line with these findings, a similar tendency was reported by the SAVACG survey in 1995[54]. This tendency may well be a reflection of the effects of urbanization, which is known to be associated with decreased prevalence of breastfeeding practices[55]. However, it should be borne in mind that the data on the duration of breastfeeding was obtained by recall and mothers/caregivers may have given an estimate of the breastfeeding duration. The prevalence of exclusive breastfeeding was not determined in this survey and should be further investigated. It is also of interest, however, to note that a smaller percentage (<10%) of 1 - 3 year old children were still being fed formula when compared with being breastfed (19%), practices that were equally common in both rural and urban areas.

Finally, the attitude of the survey population towards the use of vitamin and mineral supplements as well as food fortification was overwhelmingly positive in relation to perceived health benefits with four out of ten respondents already buying fortified foods and being prepared to pay more for fortified products. This is in line with findings in the USA[56] where fortified foods have been reported to be important contributors to vitamin and mineral intake and the use of such supplements is considered common behaviour[57]. Certainly, this is an important finding that needs to be capitalized upon in any future education/promotion campaigns on food fortification.

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