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The National Food Consumption Survey (NFCS): South Africa, 1999

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Abstract

Objective: The aim of the National Food Consumption Survey (NFCS) in South Africa was to determine the nutrient intakes and anthropometric status of children (1–9 years old), as well as factors that influence their dietary intake.

Design: This was a cross-sectional survey of a nationally representative sample of all children aged 1–9 years in South Africa. A nationally representative sample with provincial representation was selected using 1996 Census information.

Subjects: Of the 3120 children who were originally sampled data were obtained from 2894, a response rate of 93%.

Methods: The sociodemographic status of each household was assessed by a questionnaire. Dietary intake was assessed by means of a 24-hour recall and a food-frequency questionnaire from the caregivers of the children. Food purchasing practices were determined by means of a food procurement questionnaire. Hunger was assessed by a modified hunger scale questionnaire. Nutritional status was determined by means of anthropometric measurements: height, weight, head circumference and arm circumference.

Results: At the national level, stunting (height-for-age below minus two standard deviations (<-2SD) from the reference median) was by far the most common nutritional disorder, affecting nearly one in five children. The children least affected (17%) were those living in urban areas. Even with regard to the latter, however, children living in informal urban areas were more severely affected (20%) compared with those living in formal urban areas (16%). A similar pattern emerged for the prevalence of underweight (weight-for-age <-2SD), with one in 10 children being affected at the national level. Furthermore, one in 10 (13%) and one in four (26%) children aged 1–3 years had an energy intake less than half and less than two-thirds of their daily energy needs, respectively. For South African children as a whole, the intakes of energy, calcium, iron, zinc, selenium, vitamins A, D, C and E, riboflavin, niacin, vitamin B_6 and folic acid were below two-thirds of the Recommended Dietary Allowances. At the national level, data from the 24-hour recalls indicated that the most commonly consumed food items were maize, sugar, tea, whole milk and brown bread. For South African children overall, one in two households (52%) experienced hunger, one in four (23%) were at risk of hunger and only one in four households (25%) appeared food-secure.

Conclusion: The NFCS indicated that a large majority of households were food-insecure and that energy deficit and micronutrient deficiencies were common, resulting in a high prevalence of stunting. These results were used as motivation for the introduction of mandatory fortification in South Africa.

Keywords
Nutritional status
Dietary intake
Dietary survey
Children
Macronutrients
Micronutrients

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> *Children are the major repository of South Africa's potential human capital for the future. The fact that children are the workers, scientists, parents, leaders and civil society participants of tomorrow means that their survival, health, nutrition and educational progress are key issues for reconstruction and development today.* (Nelson Mandela, May 1996)[1]

In 1994 the South African population was estimated to be 40.6 million, with Africans accounting for 76% of this total[2]. Thirty-seven per cent (14.8 million) of the population was less than 5 years of age and nearly two-thirds were living in non-urban areas[2]. Poverty was reported to be most severe in non-urban areas, with the rate in these areas being 74%[3–5]. The infant mortality rate for African infants was 86 per 1000 live births and 94 for non-urban infants. The under-fives mortality rate for African children was 125 per 1000 live births and 139 in non-urban areas[6].

In 1994, a comprehensive national survey on the nutritional status of pre-school children[7] documented that one in four children was stunted and one in 10 was underweight. This national survey also found that one in three children had marginal vitamin A status ($<20\,\mu g/dl$), a prevalence that was highest in non-urban areas among children with poorly educated mothers. Additionally, one in five children was found to be anaemic (haemoglobin <11 g/dl). Children with marginal vitamin A status were also at a significantly higher risk of being anaemic and of having iron-deficiency anaemia[7]. These findings were supported by a meta-analysis of dietary surveys since 1979[8], which indicated that non-urban African children had the lowest energy and macronutrient intakes.

Against this background of undernutrition, and the widely accepted principle that inadequate dietary intake is one of the primary immediate determinants of malnutrition[9], the Nutrition Directorate of the Department of Health (DoH), within the scope of its Integrated Nutrition Programme, commissioned the National Food Consumption Survey (NFCS) in 1999. Its aim was to assess quantitatively the nutrient intakes and anthropometric status of children aged 1–9 years, as well as factors that influence their dietary intake. The present paper reports selected key findings of the NFCS[10].

Methods

Survey design

This was a cross-sectional survey of a nationally representative sample of all children aged 1–9 years in South Africa. A nationally representative sample with provincial representation was selected using 1996 Census information[11].

Survey population

This initial sample was adapted by means of 50% oversampling to accommodate for children who would not be at home at the time of the survey (approximately 25%) and allowing for an over-representation (approximately 25%) of children living in high-risk areas (low socio-economic status). The total final sample included 3120 children.

Sampling strategy

An enumerator area (EA) was defined as the EA drawn up for the 1996 Census[11]. In formal/informal urban and tribal areas, only EAs with at least 16 qualifying households were considered for inclusion in the sample, whereas in commercial farms only EAs with at least six qualifying households were considered for inclusion in the sample. EAs with hostels and special institutions, as well as EAs classified as 'other rural' in the 1996 Census, were excluded from the sample. All other qualifying EAs for the survey were randomly selected. In total 156 EAs were included in the survey, 82 of which were urban and 74 non-urban. The distribution of EAs per province was determined proportionately to the distribution of the total population and the urban/non-urban distribution in each province[11]. A qualifying household (HH) was defined as any household with at least one child aged between 1 and 9 years in it. One child only in each randomly selected HH ($n = 20$ per EA) was included in the survey. If there was more than one child present in the prescribed age interval in a HH, then all children in the HH were numbered in age order, so that a single child could be selected at random using a random number table. The survey was implemented nationally between February and July 1999.

Questionnaires

The following questionnaires, completed in the sequence given below, were designed, tested, validated and used in the survey:

- *The Sociodemographic Questionnaire (S-DQ)* provided information on factors relevant to the household regarding the environment in which the child lived.
- *The 24-Hour Recall Questionnaire (24-H-RQ)* provided information on the current diet and eating pattern of the child.
- *The Quantitative Food-Frequency Questionnaire (QFFQ)* provided information on the eating patterns and intake over the previous 6 months for children older than 2 years and over 1 month for children aged between 12 and 23 months. Consequently seasonality effects could be observed.
- *The Food Procurement and Household Food Inventory Questionnaire (FPHIQ)* provided information on purchasing patterns and storage of food. The Food Procurement section of the questionnaire was completed in all HHs, whereas the Food Inventory section was completed in all HHs in high-risk areas, as well as in one randomly selected HH in all other EAs.

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- *The Hunger Scale Questionnaire (HSQ)* provided information on the caregiver's perception of whether hunger was experienced in the HH and by the child.

To assist the fieldworkers in quantifying the portion sizes of foods eaten by children, a specially designed kit with food model aids was used for the quantification of food throughout the survey. This kit included wax and foam models of commonly eaten food items, household utensils, dry food (e.g. beans) as well as empty containers. Each fieldworker had been trained using a video made specifically for the survey, and also had a manual with detailed information regarding the correct and standardised completion of all questionnaires.

Anthropometric assessment

A trained fieldworker followed standardised and internationally accepted methodology[12] to take each subject's weight and height. Each fieldworker was equipped with a portable electronic scale and a standard weight for standardising the scale, a measuring board and a stadiometer. The data were compared with those of the US National Center for Health Statistics (NCHS) reference population[13] using Epi-Info Version 6.02[14,15].

Quality control

This integral part of the study was implemented for the QFFQ and anthropometric measurements in two HHs for each EA. Essentially, two HHs per EA were randomly selected after all 20 HHs that were included in the EA had completed the survey. In the two randomly selected HHs the QFFQ and the anthropometric measurements were completed again on the same day, but this time by a different fieldworker. The quality control exercise was implemented in every EA and in every province. To validate the questionnaires, data obtained from the QFFQ were compared with those obtained from three separate 24-H-RQs. For the purposes of the survey, repeatability meant the ability of the fieldworker to obtain as accurate information as possible from the same interviewee one week apart. To achieve this, one HH was selected randomly by the co-ordinator in a manner similar to that for 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.

Ethics

The survey protocol was approved by the Ethics Committee of the University of Stellenbosch. Written, informed consent was obtained from the mother/caregiver of each child included in the survey.

Data analysis

After completion of the protocol in an EA, the questionnaires were checked and dispatched to a central site for data entry. The questionnaires were again checked by a dietitian and the data were then entered. SAS Version 6.12 for Windows (SAS Institute, Cary, NC, USA) was used for data entry and analyses under the supervision of two statisticians.

Descriptive statistics (means, standard deviations (SDs), medians, interquartile ranges) and frequency distributions were calculated for all nutrients and food groups. Associations between food, energy and nutrient intakes and the variables age, gender and level of urbanisation were calculated. The independent *t*-test was used to compare results of urban versus rural, male versus female for nutrient intake. The Spearman's correlation was used to obtain an indication of any relationships/trends between some anthropometric parameters and other variables such as household income. The Pearson's correlation was used for detecting relationships/trends between continuous variables, such as anthropometry, and nutrient intake. Confidence intervals (CIs) were also calculated as appropriate. Odds ratios (ORs) with corresponding 95% CIs were calculated to provide an indication of the severity of the risk factor. For the analysis of data from the HSQ, the sample was divided into three groups: 'food-secure', 'at-risk' and 'experiences hunger'. These three groups were compared in relation to anthropometric status, nutrient intake and some socio-economic parameters using primarily the Kruskal–Wallis test. The Bonferroni test in conjunction with the Kruskal–Wallis test was also used primarily for an indication of direction, whereas the chi-square test was used to establish for instance relationships between different hunger groups and different areas of residence. When looking at the individual questions of the questionnaire, each question had two outcomes, 'yes' and 'no'. For each question, two groups were created: those who said 'yes' and those who said 'no'. Selected anthropometric parameters, nutrient intakes as well as socio-economic variables were also compared for these two groups using the Wilcoxon test (non-parametric). Factor analysis with varimax rotation was also calculated.

Energy and nutrient composition was analysed using the computerised food composition tables of the South African Medical Research Council[16]. Food groups were analysed according to the groups used on the QFFQ.

Results

Anthropometric status

At the national level, stunting (height-for-age < -2SD from the NCHS reference median) was by far the most common nutritional disorder, affecting nearly one in five children (Table 1). On commercial farms, this disorder affected nearly one in three children, whereas one in four children were similarly affected in the tribal or (collectively) rural areas. The children least affected (17%) were those living in urban areas. Even with regard to the latter, however, children living in informal urban areas were affected more

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severely (20%) than those living in formal urban areas (16%). The prevalence of severe stunting (height-for-age <-3SD) was also higher in children living on commercial farms (12.5%) as well as in rural (8%) and tribal (7%) areas compared with the national average (6.5%).

A similar pattern emerged for the prevalence of underweight (weight-for-age <-2SD), with one in 10 children being affected at the national level (Table 1). Nationally, less than 1.5% of children were severely underweight (weight-for-age <-3SD), except on commercial farms where the prevalence was 5%. Wasting (weight-for-height <-2SD) was by far less prevalent, affecting one in 20 children living in rural and tribal areas as well as on commercial farms, with severe wasting (weight-for-height <-3SD) being even less common (<1%) at the national level (Table 1).

By contrast, the prevalence of combined overweight and obesity (body mass index $\geq 25\ \text{kg m}^{-2}$) at the national level (17.1% (95% CI = 15.00–19.23)) was nearly as high as that for stunting[17] (Table 2). Furthermore, the determinants for stunting and overweight were generally similar (although directionally opposite in degree of risk conferred) and included: type of housing, type of toilet in the home, fuel used in cooking, presence of refrigerator/stove, television in the house, educational level of the caregiver and maternal education level. An example of the directionally opposite degree of risk is exemplified by the use of paraffin as fuel being protective against being overweight (OR = 0.78, 95% CI = 0.63–0.97) while being predictive of an increased risk for stunting (OR = 1.24, 95% CI = 1.04–1.48). Stunting, itself, conferred an increased risk (OR = 1.80, 95% CI = 1.48–2.20) of being overweight.

The prevalence of stunting decreased with age from 25.5% in children aged 1–3 years to 21% in those aged 4–6 years and to 13% in those aged 7–9 years. A similar but less marked pattern emerged for the prevalence of underweight, the prevalence for children aged 1–3, 4–6 and 7–9 years being 13%, 8% and 8%, respectively. The prevalence of wasting remained constant in all age groups at less than 4%.

Improved maternal education was associated with a significant reduction in the prevalence of stunting, underweight and wasting in all age groups of children. A significant correlation (Spearman's) was found between the level of maternal education and stunting at the national level ($r = 0.17$; $P < 0.0001$) and for children living in urban areas ($r = 0.20$; $P < 0.0001$).

Children living in houses built with bricks or concrete had the lowest overall prevalence of stunting in all age groups. However, this appeared to be the case only for those children living in urban but not rural areas. The type of dwelling was related with stunting nationally ($r = -0.10$; $P < 0.0001$), for children living in urban areas ($r = -0.16$; $P < 0.0001$) and for underweight children living in urban areas ($r = -0.12$; $P < 0.001$).

Table 1 Anthropometric status of children aged 1–9 years nationally and by area of residence: South Africa, 1999

Anthropometric parameter	Area of residence						
	Commercial farms	Formal urban	Informal urban	Tribal	Urban	Rural	RSA
n	288	1019	290	1016	1309	1304	2613
Height-for-age <-2SD (%)	30.6 (25.2–35.9)	16.0 (13.7–18.3)	19.3 (14.7–23.9)	25.3 (22.6–28.0)	16.7 (14.7–18.8)	26.5 (24.1–28.9)	21.6 (20.0–23.2)
Weight-for-age <-2SD (%)	18.1 (13.5–22.5)	7.8 (6.1–9.4)	7.6 (4.5–10.7)	11.3 (9.4–13.3)	7.7 (6.3–9.2)	12.8 (11.0–14.6)	10.3 (9.1–11.4)
Weight-for-height <-2SD (%)	4.2 (1.8–6.5)	2.6 (1.6–3.5)	2.1 (0.4–3.7)	5.1 (3.8–6.5)	2.4 (1.6–3.3)	4.9 (3.7–6.1)	3.7 (3.0–4.4)
Height-for-age <-3SD (%)	12.5 (8.7–16.3)	4.9 (3.6–6.2)	3.8 (1.6–6.0)	7.2 (5.6–8.8)	4.7 (3.5–5.8)	8.4 (6.9–9.9)	6.5 (5.6–7.5)
Weight-for-age <-3SD (%)	4.9 (2.4–7.4)	1.1 (0.4–1.7)	1.0 (0.0–2.2)	0.9 (0.3–1.5)	1.1 (0.5–1.6)	1.8 (1.0–2.5)	1.4 (1.0–1.9)
Weight-for-height <-3SD (%)	1.4 (0.0–2.7)	0.5 (0.0–0.9)	0.0 (0.0–0.0)	1.3 (0.6–2.0)	0.4 (0.0–0.7)	1.3 (0.7–1.9)	0.8 (0.5–1.2)
Weight-for-height >2SD (%)	2.4 (0.6–4.2)	8.1 (6.5–9.8)	5.9 (3.1–8.6)	4.9 (3.6–6.3)	7.6 (6.2–9.1)	4.4 (3.3–5.5)	6.0 (5.1–6.9)

RSA – Republic of South Africa; SD – standard deviation.
Value in parentheses is 95% confidence interval.

Table 2 Percentage of children in standard body mass index (BMI) categories for 1–8-year-olds[17], analysis according to area of residence and age group: South Africa, 1999

	Domain analysis by area of residence*				Domain analysis by urban/rural*		Domain analysis by age group*			
BMI cut-off points	Farms ($n = 108$)	Formal urban ($n = 946$)	Informal urban ($n = 272$)	Tribal ($n = 874$)	Rural ($n = 982$)	Urban ($n = 128$)	1–3 years ($n = 795$)	4–6 years ($n = 861$)	7–8 years ($n = 544$)	National ($n = 2200$)
$< 25\,kg\,m^{-2}$ (%)	89.2	79.9	86.6	84.2	84.7	81.4	76.2	84.2	90.5	82.9
Lower 95% CI	84.50	75.80	83.20	81.86	82.60	77.94	73.38	81.25	87.31	80.77
Upper 95% CI	93.97	83.99	89.98	86.48	86.85	84.85	79.13	87.16	93.63	84.99
$25–30\,kg\,m^{-2}$ (%)	7.2	13.9	7.5	12.1	11.6	12.5	16.0	12.0	6.5	12.1
Lower 95% CI	3.17	10.97	5.04	10.06	9.63	9.97	13.70	9.59	4.22	10.45
Upper 95% CI	11.29	16.88	10.00	14.12	13.49	15.01	18.23	14.37	8.89	13.70
$\geq 30\,kg\,m^{-2}$ (%)	3.5	6.2	5.9	3.7	3.7	6.1	7.8	3.8	3.0	5.0
Lower 95% CI	0.77	4.40	3.15	2.55	2.64	4.55	6.07	2.50	1.13	4.07
Upper 95% CI	6.30	7.96	8.63	4.93	4.79	7.67	9.49	5.12	4.83	6.02
$25\,kg\,m^{-2}$ (%)†	10.8	20.1	13.4	15.8	15.3	18.6	23.7	15.8	9.5	17.1
Lower 95% CI	6.03	16.01	10.02	13.52	13.15	15.15	20.87	12.84	6.37	15.00
Upper 95% CI	15.50	24.19	16.80	18.14	17.40	22.06	26.62	18.75	12.69	19.23
P-value‡		0.0066			0.0257			< 0.0001		
P-value§		0.0054			0.0392			< 0.0001		

CI – confidence interval.
* Weighted sample used.
† Refers to overweight and obesity combined
‡ Chi-square *P*-value for testing for associations, using weighted values, between BMI groupings, area of residence, urban/rural and age groups.
§ Chi-square *P*-value for testing for associations, using unweighted values, between BMI groupings, area of residence, urban/rural and age groups.

Eating patterns

Almost 90% of children of all age groups ate breakfast regularly irrespective of area of residence. A significant percentage of children (10–20%), however, ate breakfast only occasionally in Gauteng, KwaZulu/Natal, Mpumalanga, Northern Cape and Northern Province. The greatest majority of children of all ages (87%) shared the family's main meal in all areas of residence with notable exceptions in KwaZulu/Natal, Mpumalanga and Northern Province, where 16–30% of children had food specially bought and prepared for them.

The main meal pattern for children of all ages was primarily that of three daily meals, with (44%) or without (31%) in-between meals. This was the pattern, irrespective of area of residence, in all provinces. Notable exceptions were North West Province, where almost one in five children ate two daily meals with in-between meals, and Gauteng, where 14% of children ate two daily meals without in-between meals. One-third of children ate away from home at the houses 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.

Energy intake

On the basis of the QFFQ, children, especially of the older age groups, in the Free State, Mpumalanga, Northern Cape, Northern Province and North West Province consistently had a lower mean energy intake than that recommended (Table 3). Among 1–3-year-olds, energy intake was lowest in Mpumalanga (3818 kJ); among 4–6-year-olds in Northern Cape (4990 kJ); and among 7–9-year-olds also in Northern Cape (5790 kJ). The three provinces with the highest energy intake for all age groups were Western Cape, Gauteng and KwaZulu/Natal. At the national level, one in 10 (13%) and one in four (26%) children aged 1–3 years had an energy intake less than half and less than two-thirds of their daily energy needs, respectively. Indeed, in Northern Cape, Mpumalanga, Northern Province and the Free State, overall one in 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. No gender differences were seen.

Energy intake was significantly ($P < 0.0001$) correlated with height-for-age (Pearson's correlation, $r = 0.14$) and weight-for-age ($r = 0.15$) in all age groups in five and four of the nine provinces, respectively. Furthermore, significant correlations with energy intake were also found among children living in rural and urban areas (height-for-age, weight-for-age), formal urban areas (height-for-age, weight-for-height), tribal areas (height-for-age, weight-for-height) and on commercial farms (weight-for-age). Correlations (Spearman's) of the same frequency, magnitude and significance were 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: height-for-age ($P < 0.05$) in five provinces, weight-for-age ($P < 0.05$) in seven provinces, height-for-age in rural areas, height-for-age and weight-for-age in urban and formal urban areas as well as commercial farms, and height-for-age in tribal areas.

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Table 3 Mean energy intake (kJ) of children by age, province and area of residence: South Africa, 1999

		Province												
Age group	Energy intake (kJ)	EC	FS	G'teng	KZN	M'ga	NC	NP	NW	WC	RSA	Urban	Rural	*P*-value (*t*-test)
1–3 years (RDA = 5460 kJ)	*n*	162	85	230	230	58	79	126	115	149	1249	631	603	U/R = 0.0
	Mean	6391	4690	6207	5444	3818	3973	5343	5504	7156	5650	6054	5319	Gender = 0.5
	SD	2692	2426	2674	2221	2531	2067	3004	2306	2400	2660	2611	2665	
	Median	6141	4442	5846	5055	3062	3478	4576	5384	7078	5282	5878	4898	
	IQR	4609–8045	2852–5576	4375–7532	3761–6747	2275–4183	2330–2067	2943–7022	3440–6721	5137–8731	3585–7185	4078–7555	3316–6728	
4–6 years (RDA = 7200 kJ)	*n*	166	77	131	212	61	54	133	81	122	1044	490	547	Gender = 0.1
	Mean	7585	5388	7724	6739	7056	4990	6023	6352	9600	7025	7456	6668	U/R = 0.001
	SD	2850	2966	3373	2487	3872	2483	3338	2949	3025	3249	3193	3228	
	Median	7385	4953	7190	6437	6378	4556	4990	5760	9559	6529	6914	6098	
	IQR	5514–9494	3204–6984	5310–9088	5113–8316	4008–9072	3350–6405	3471–7720	4258–7958	7462–11 570	4676–8870	5285–9271	4254–8668	
7–9 years (RDA = 8400 kJ)	*n*	86	27	51	102	33	18	59	33	62	476	239	232	U/R = 0.001
	Mean	8295	5898	8783	8190	7039	5790	6730	6229	10 611	7901	8546	7373	Gender = 0.8
	SD	3535	4430	3822	3736	3756	2997	3460	2429	3542	3843	3827	3733	
	Median	7493	4306	8922	7456	6180	5249	6129	5921	10 370	7257	8324	6426	
	IQR	5586–10 233	3037–7498	5805–10 664	5466–10 238	4313–8568	3443–8017	3866–8532	4423–7490	7912–12 776	5025–10 213	5786–11 273	4250–9257	
1–3 years	<50% RDA (%)	8	26	7	7	43	36	21	13	1	13	10	17	
	<67% RDA (%)	17	37	18	16	64	54	37	26	6	26	21	30	
	>100% RDA (%)	60	26	56	43	21	24	39	49	71	47	55	39	
4–6 years	<50% RDA (%)	7	31	5	10	21	36	30	15	1	15	10	18	
	<67% RDA (%)	18	48	17	19	39	54	47	35	4	27	20	32	
	>100% RDA (%)	38	21	49	38	40	24	31	33	79	43	48	38	
7–9 years	<50% RDA (%)	6	43	8	12	26	33	31	24	0	16	14	18	
	<67% RDA (%)	21	71	20	28	27	56	46	49	3	32	25	40	
	>100% RDA (%)	38	21	53	34	26	22	25	18	70	40	49	30	

EC – Eastern Cape; FS – Free State; G'teng – Gauteng; KZN, KwaZulu/Natal; M'ga – Mpumalanga; NC – Northern Cape; NP, Northern Province; NW – North West Province; WC – Western Cape; RSA – Republic of South Africa; RDA – Recommended Dietary Allowance; SD – standard deviation; IQR – interquartile range.

Distribution of energy

In terms of the energy distribution of the diet (Table 4), total fat, as a percentage of total energy intake, was less than 30% in all provinces with the exception of 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 Western Cape (55%) and Gauteng (58%). Sugar, as a percentage of energy intake, was highest in Western Cape (15%) and Northern Cape (13%) and lowest in the Free State, Northern Province and Mpumalanga. The ratio of polyunsaturated to saturated fats ranged from 0.9 in Gauteng and Western Cape to 1.4 in Eastern Cape and Northern Province. Girls had a significantly higher percentage contribution to energy from fat ($P < 0.01$) compared with boys. Furthermore, children living in rural areas had a significantly greater ($P < 0.0001$) percentage of energy contributed from protein of plant origin, a pattern that tended to be also similar at the national level. The differences in energy distribution for children living in urban versus rural areas were statistically significant ($P < 0.0001$).

Micronutrient intakes

In general, approximately one in two children of all ages and in all provinces except Western Cape had a vitamin A intake less that two-thirds of the Recommended Dietary Allowance (RDA).

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

The mean calcium intake was less than half that recommended in almost 95% of children in most provinces with the exception of Western Cape. At the national level, one in two and three in four children, respectively, had an intake less than half and less than two-thirds of the recommended intake. Urban–rural differences in intake were significant ($P < 0.001$ to 0.0003) in all age groups.

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

Similarly to iron, the mean intake of zinc was inadequate in all age groups and in all provinces. At the national level, 32–53% and 50–73% of children

Table 4 Energy distribution of macronutrients and nutrient ratios status of children aged 1–9 years: South Africa, 1999

	Gender		Province											
Nutrient	Boys	Girls	EC	FS	G'teng	KZN	M'ga	NC	NP	NW	WC	RSA	Urban*	Rural*
Protein (%E)	12.0 ± 2.6	12.2 ± 2.6	11 ± 2	11.8 ± 3	13 ± 2.6	11.5 ± 2.5	12.9 ± 3	13 ± 3	13 ± 3.3	12 ± 2	12.2 ± 2	12.1 ± 3	12.5 ± 3	11.8 ± 3
Animal protein (%E)	5.3 ± 3.3	5.5 ± 3.3	3.8 ± 2.7	5.3 ± 3.2	5.2 ± 4	4.4 ± 3	5.7 ± 3.8	6.5 ± 4	6.4 ± 3	6 ± 2.4	7 ± 2.5	5.5 ± 3	6.2 ± 3	4.5 ± 3.3
Plant protein (%E)	6.6 ± 1.7	6.5 ± 1.7	7 ± 1.6	6.5 ± 1.4	7.6 ± 1.7	7.1 ± 1.6	1.9 ± 7.1	6.3 ± 1.4	5.9 ± 1.5	6 ± 1.1	5 ± 1.4	6.6 ± 2	6 ± 1.6	7.2 ± 1.6
Total fat (%E)†	41 ± 27	43 ± 29	21 ± 7	20 ± 8	27 ± 7	22 ± 7	22 ± 9	21 ± 7.5	21 ± 7	23 ± 6	30 ± 6	23 ± 8	26.5 ± 7.7	21 ± 7.9
Saturated fat (%E)	11.1 ± 2.9	11.7 ± 2.9	5 ± 2.5	5 ± 2.5	7.7 ± 2.5	6 ± 3	6 ± 3.5	6 ± 2.6	5.5 ± 3	6 ± 2	9 ± 2	6 ± 3	7.3 ± 2.7	5.5 ± 2.7
Monounsaturated fat (%E)	13.6 ± 3.3	14.1 ± 3.2	6 ± 2.6	7 ± 3	10 ± 3	8 ± 3	7 ± 3.5	7 ± 3	6.8 ± 3.7	8 ± 2	10.5 ± 2.4	8 ± 3	8.9 ± 3	6.7 ± 3.1
Polyunsaturated fat (%E)‡	10.1 ± 2.5	11.0 ± 2.8	6.5 ± 2.8	5 ± 3	6.5 ± 2	6 ± 3	6 ± 2.6	5.5 ± 2.3	6.2 ± 3.2	6 ± 2	7 ± 2	6 ± 2.5	6.5 ± 2.4	6 ± 2.8
Carbohydrate (%E)§	61.8 ± 8.9	60.9 ± 8.9	65 ± 8	65 ± 9	58 ± 7	62 ± 8	62 ± 10	63 ± 9.5	63 ± 10	62 ± 6.6	55 ± 6	62 ± 9	58 ± 8	64 ± 9
Sugar (%E)	11.0 ± 7.1	10.8 ± 6.9	11 ± 6	9 ± 8	12 ± 6	10.5 ± 6.5	9.4 ± 6.7	13 ± 9	6.5 ± 6.3	11 ± 6	15 ± 6	11 ± 7	12 ± 6.6	10 ± 7.1
P/S ratio	1.1 ± 0.6	1.1 ± 0.5	1.4 ± 0.7	1.2 ± 0.6	0.9 ± 0.32	1.1 ± 0.6	1.3 ± 0.6	1.1 ± 0.5	1.4 ± 0.7	1.1 ± 0.4	0.9 ± 0.3	1.1 ± 0.6	1.0 ± 0.5	1.3 ± 0.7

EC – Eastern Cape; FS – Free State; G'teng – Gauteng; KZN, KwaZulu/Natal; M'ga – Mpumalanga; NC – Northern Cape; NP, Northern Province; NW – North West Province; WC – Western Cape; RSA – Republic of South Africa; %E – percentage of energy; P/S ratio – ratio of polyunsaturated to saturated fat.
Values are mean ± standard deviation.
Means significantly different, urban vs. rural: *, $P < 0.0$.
Means significantly different, boys vs. girls: †, $P < 0.01$; ‡, $P < 0.001$; §, $P < 0.01$.

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respectively had an intake less than 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.

For South African children as a whole, the intakes of energy, calcium, iron, zinc, selenium, vitamins A, D, C and E, riboflavin, niacin, vitamin B_6 and folic acid were below two-thirds of the RDAs.

Food procurement and household food inventory

At the national level, the data from the 24-H-RQ indicated that the most commonly consumed food items were maize, sugar, tea, whole milk and brown bread (Table 5). These same food items together with hard margarine were also identified as being the most commonly consumed foods by the QFFQ. It is equally important to note that these same six items were also the ones that were the most frequently procured and the ones that were found most frequently in the house. Indeed, the agreement of the findings obtained by the three different methodologies is rather substantial, especially for the non-perishable food items.

The national average number of food items procured by HHs was 35. At the provincial level, this number of procured food items varied from 16 in Free State to as high as 67 in Western Cape. HHs in tribal areas also had a lower number of procured food items (26) as compared with formal (45) and informal (34) urban areas. However, the number of food items actually found in the HH, according to the HH food inventory, was considerably lower than the number procured, with the national average being nine food items per HH. At the provincial level, the provinces with the lowest (five) and highest (17) number of food items in the HH inventory were Free State and Western Cape, respectively. Little variation was seen, however, between the number of food items present in rural and urban HHs (respectively eight and 10 items per HH).

The frequency of consumption of the first 25 most frequently consumed food items was analysed according to income as obtained from both the S-DQ and the Census 1996 data[11]. Overall, it appeared that maize and sugar were consistently procured and consumed in all HHs in almost all provinces, irrespective of income. HHs with the higher income tended to have a more frequent consumption of protein of animal origin. Nevertheless, HHs with lower income procured a significantly lower mean number of food items in all provinces and all areas of residence, when compared with HHs with higher income (Tables 6 and 7) . This was the case irrespective of whether the income data used to stratify HHs were obtained from the 1996 Census[11] data or the S-DQ of the present survey. These findings are strongly supported by those of the HH inventory, namely that HHs in the lower income group had significantly fewer food items in the house at the time of the interview. Further support regarding the impact of income on food procurement and HH inventory is provided by the significantly fewer average number of food items consumed by children as determined by the QFFQ and the 24-H-RQ (data not shown)[10]. It is therefore important to note that all four methodologies employed collectively support the role of income as being decisive in the consumption and procurement of foods.

Hunger

At the national level, one in two HHs (52%) experienced hunger, one in four (23%) were at risk of hunger and only one in four HHs (25%) appeared food-secure (Table 8). In the rural areas a significantly (chi-square; $P < 0.001$) higher percentage (62%) of HHs experienced hunger than HHs in the urban areas (42%). HHs in informal urban and tribal areas as well as on commercial farms were the worst affected. The prevalence of hunger or being at risk of hunger was similar in all HHs irrespective of the age of the child. At the provincial level, HHs in Eastern Cape had the highest percentage of hunger (83%), followed by Northern Cape (63%), North West Province (61%), Northern Province (54%) and Mpumalanga (53%). The differences in the prevalence of hunger between provinces were significant ($P < 0.001$).

It is also of interest to note that, at the national level, a significantly ($P < 0.001$) poorer anthropometric status was found in HHs at risk of hunger or experiencing hunger as

Table 5 Association between consumption and procurement as determined by the 24-Hour Recall Questionnaire (24-H-RQ), the Quantitative Food-Frequency Questionnaire (QFFQ) and the Food Procurement and Household Food Inventory Questionnaire (FPHIQ): South Africa, 1999

Food item	Children consuming the food item (24-H-RQ)	Children consuming the food item (QFFQ)	Families procuring the food item (FPHIQ)
n	2868	2883	2812
Maize (%)	78	94	94
Sugar (%)	76	90	93
Brown bead* (%)	37	61	52
Tea (%)	46	65	78
Whole milk (%)	42	61	58
Fat (hard margarine/cooking fat) (%)	27	54	59

* Brown bread includes brown bread, whole-wheat bread, brown flours and whole-wheat flours.

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Table 6 Number of food items procured by households (HHs) as determined by the Food Procurement and Household Food Inventory Questionnaire ($n = 2812$) and according to HH income (South African Rands, R) as determined by the Census 1996: South Africa, 1999

	Annual HH income ≤ R12 000			Annual HH income ≥ R12 000		
		No. of food items procured			No. of food items procured	
Province/area of residence	No. of HHs*	Mean	SD	No. of HHs*	Mean	SD
Eastern Cape	301	33.2	10.4	125	39.0	16.2
Free State	142	16.0	7.4	66	14.9	8.4
Gauteng	108	32.0	13.7	265	41.4	22.6
KwaZulu/Natal	294	32.3	12.1	253	43.3	17.1
Mpumalanga	58	20.4	11.8	104	26.0	18.3
Northern Cape	61	19.0	11.1	96	25.9	10.5
Northern Province	259	14.6	10.9	98	24.2	12.3
North West Province	100	30.2	6.9	126	36.6	12.7
Western Cape	38	49.9	16.1	318	69.0	21.5
Urban	430	29.3	14.3	940	49.0	25.2
Rural	931	25.4	13.8	511	31.0	16.4
Commercial farms	40	29.0	23.6	262	32.0	19.1
Formal urban	253	28.1	13.4	820	50.7	25.9
Informal urban	177	30.9	15.3	120	37.4	14.6
Tribal	891	25.3	13.2	249	29.9	12.9
RSA	1361	26.6	14.1	1451	42.6	24.0

SD – standard deviation; RSA – Republic of South Africa.
* The number of subjects who answered the question on income in the sociodemographic questionnaire.

determined on the basis of the interviewee's response (Fig. 1). This trend was significant for stunting for HHs in urban and formal urban areas, as well as for HHs on commercial farms. In the case of underweight and wasting, this trend was significant for HHs in urban and formal urban areas only. Although the mean *Z*-scores did not differ significantly across the age groups, there was a significant difference ($P < 0.01$; 0.05) between the mean *Z*-score of children in HHs at risk of hunger or experiencing hunger and food-secure HHs. Also at the national level, the energy and micronutrient intakes of children were lowest in the HHs that experienced hunger. This was the case in all areas of residence. Children in such HHs in the rural areas had a lower energy intake, the lowest of which was recorded in children living in HHs on commercial farms (data not shown)[10].

Table 7 Number of food items procured by households (HHs) as determined by the Food Procurement and Household Food Inventory Questionnaire ($n = 2812$) and according to HH income (South African Rands, R) as determined by the Sociodemographic Questionnaire: South Africa, 1999

	Annual HH income ≤ R12 000			Annual HH income ≥ R12 000		
		No. of food items procured			No. of food items procured	
Province/area of residence	No. of HHs*	Mean	SD	No. of HHs*	Mean	SD
Eastern Cape	333	33.6	11.5	42	41.2	19.0
Free State	161	15.4	7.0	19	23.6	11.1
Gauteng	194	32.6	13.4	120	52.6	25.4
KwaZulu/Natal	357	34.5	12.8	106	49.2	18.9
Mpumalanga	87	16.8	8.7	57	34.0	20.6
Northern Cape	100	24.5	11.0	41	22.4	12.1
Northern Province	186	15.4	12.0	100	22.4	11.1
North West Province	179	32.8	10.4	29	38.4	13.3
Western Cape	119	55.3	18.8	213	73.7	20.7
Urban	701	33.9	17.7	503	56.8	26.3
Rural	1015	27.3	13.9	224	31.4	19.3
Commercial farms	189	30.4	17.0	75	39.1	24.8
Formal urban	496	34.8	18.9	452	58.6	26.7
Informal urban	205	31.9	14.4	51	41.5	16.5
Tribal	826	26.6	13.0	149	27.5	14.5
RSA	1716	30.0	15.9	727	49.0	27.1

SD – standard deviation; RSA – Republic of South Africa.
* The number of subjects who answered the question on income in the sociodemographic questionnaire.

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Table 8 Hunger risk classification in children aged 1–9 years nationally and by area of residence: South Africa, 1999

Hunger risk classification	Area of residence						
	Commercial farms*	Formal urban*	Informal urban*	Tribal*	Urban†	Rural†	RSA
n	299	1060	287	1089	1347	1388	2735
Food-secure (%)	23	41	21	11	36	14	25
At risk of hunger (%)	29	23	18	23	22	24	23
Experiences hunger (%)	48	37	61	66	42	62	52

RSA – Republic of South Africa.
Significant difference between the four types of residence for all hunger risk classification categories (chi-square test): *, $P < 0.01$.
Significant difference between urban and rural groups for all hunger risk classification categories (chi-square test): †, $P < 0.01$.

Discussion

The NFCS was an important initiative of the DoH, since for the first time there was an evaluation of the diet and dietary practices of children in South Africa to inform health policy-makers. On the basis of the survey's findings, a national food fortification task group was initiated in order to develop a framework of key activities and to make recommendations regarding the fortification of food staples[18]. These recommendations were accepted and mandatory fortification was introduced in October 2003[19]. Currently all maize and wheat flours are fortified to provide a person aged 10 years or older with the following percentage of the RDA (per 200 g of raw flour): vitamin A, 31%; thiamine, 25%; niacin, 25%; pyridoxine, 25%; riboflavin, 17% (maize flour) and 20% (wheat flour); iron, 25% (unsifted maize meal) and 50% (maize meal); and zinc, 20%. More recently, the DoH Nutrition Directorate commissioned a follow-up study of children in 2004 with the aim of monitoring the impact of fortification by establishing baseline blood micronutrients levels in children aged 1–9 years and also in women of reproductive age (16–35 years). The results of the survey are being awaited.

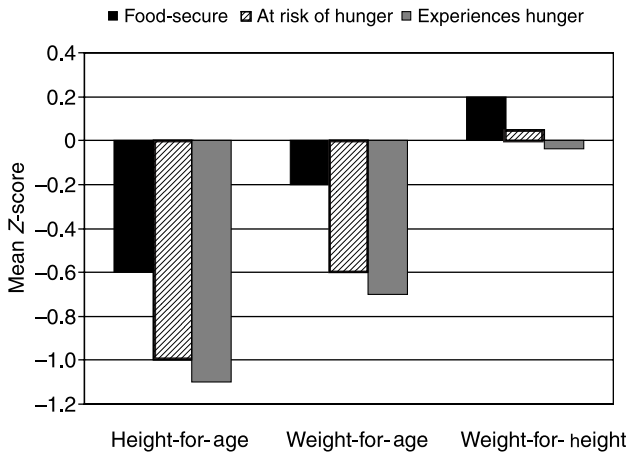

Fig. 1 Hunger risk classification as related to anthropometric status nationally in children aged 1–9 years: South Africa, 1999

The NFCS also served another very important role in the country, by providing health educators for the first time with information regarding both the quantity and quality of foods consumed by children in South Africa. Hence nutrition education tools and interventions can be based on documented evidence of food consumption in the country[20]. One such outcome, for instance, has been the use of the NFCS data to inform policy-makers on the formulation of an HIV and tuberculosis nutrition intervention programme, as well as a vitamin A supplementation programme aimed at mothers and their infants.

Another important initiative that arose from the NFCS data has been the adoption of the South African food-based dietary guidelines[21]. Dietary guidelines represent a practical way to reach nutritional goals for the population taking into account customary dietary patterns in relation to achieving healthy dietary practices[22]. The 11 adopted guidelines[23] not only address existing nutrient deficiencies and excesses, and the resulting nutrition-related public health initiatives in the country, but also take into account the documented cultural differences and eating patterns. Furthermore, these guidelines are based on affordable and available foods which are widely consumed and which encourage environmentally sound agricultural practices.

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