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Item Type	Article
Authors	Faber, M.;Smuts, C.M.;Benade, A.J.S.
Citation	Faber M, Smuts CM, Benade AJS. Dietary intake of primary school children in relation to food production in a rural area in KwaZulu-Natal, South Africa. International journal of food sciences and nutrition
Publisher	Basingstoke: Nature Publishing
Journal	International Journal of Food Science and Nutrition
Rights	Attribution 3.0 United States
Download date	2025-01-23 20:42:02
Item License	http://creativecommons.org/licenses/by/3.0/us/
Link to Item	https://infospace.mrc.ac.za/handle/11288/595236

Dietary intake of primary school children in relation to food production in a rural area in KwaZulu-Natal, South Africa

Mieke Faber, C.M. Smuts and A.J.S. Benadé

National Research Programme for Nutritional Intervention, Medical Research Council, PO Box 19070, Tygerberg 7505, South Africa

The adequacy of food intake of primary school children living in a low socioeconomic rural area, ± 60 km northwest of Durban, KwaZulu-Natal, South Africa was assessed in a cross-sectional study. Primary school children, 10 and 11 years old and in grades 5, 6 and 7, and their mothers/caretakers were interviewed. Dietary intake was assessed by a 24-h recall and an unquantified food frequency questionnaire. Local food production was assessed by questionnaire. The diet consumed by the children comprised a limited number of food items. Fruit and vegetable consumption was low, resulting in a poor intake of micronutrients. Despite the local production of some vitamin A rich food crops, the quantity grown and eaten was low. The long-term solutions for combatting micronutrient deficiencies in this rural area include targeted local food production accompanied by a nutrition education programme, to be initiated and monitored by a multi-sectoral team of agriculturists and health scientists.

Introduction

South Africa is a country that produces a food surplus and is therefore not classified by the FAO as a low-income food-deficient country (LIFDC). However, national food security does not guarantee household food security. A meta-analysis comprising 55 studies and reports showed the country to be nationally food secure, yet the dietary intakes of rural and urban black people were indicative of poor household food security (Steyn *et al.*, 1997). Important is that the initial concept of food security as *national* food self-sufficiency or food availability has been redefined in 1983 by the FAO, including the concepts of quality and quantity, accessibility, and sustainability. The most recent definition from the 1996 World Food Summit states: 'Food security is when all people, at all

times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active lifestyle' (World Food Plan of Action, World Food Summit, Rome, 1996). In a rural area known to have a severe public health problem of vitamin A deficiency (Oelofse *et al.*, submitted), we looked at aspects of household food security, in particular the nutritional quality of the diet.

Methods

Study population

The study population consisted of primary school children in a rural area and who participated in a school-based clinical trial

Correspondence to: Mieke Faber.

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looking at the influence of a combination of essential fatty acids and micronutrients on eyesight and cognitive function. The sample for the dietary survey included all 10- and 11-year-old children in grades 5, 6 and 7 ($n = 50$) and their mothers/caretakers ($n = 42$; hereafter referred to as mothers).

Measurements

A nutritionist of the Medical Research Council (MRC) trained and supervised four nutrition monitors and a community nurse in the application of the questionnaire and the recording of a 24-h dietary recall. The questionnaire was used to record and assess annual food production, various food preparation methods, individual food preferences, meal frequency, meal patterns and food frequency. Meal patterns recorded the food that was normally eaten during the various meals and in-between-meal periods. An unquantified food frequency questionnaire (previously tested and used in the same area) was used for qualitative assessment of the adequacy of food intake. Food items were listed, with space for the recording of additional items consumed but not listed on the questionnaire. The participants had a choice of six options, namely more than once a day, every day, most days (not every day, but at least 4 days per week), once a week (at least once per week, but less often than 4 days per week), seldom (less than once per week/infrequently) and never. Dietary intake was quantified, using the 24-h recall method. Fresh food, food models, household utensils and sponge models were used for quantifying and recording food intake. In addition, dry samp (commercially available coarsely broken maize) was used to quantify portion sizes of dishes made with either samp or maize. The child used the dry samp to indicate the quantity resembling the amount of food he or she ate, which the nutrition monitor then quantified into millilitres using a measuring cup. Actual food intake reported in household measures was converted into weight using the MRC *Food Quantities Manual* (Langenhoven et al., 1992a). The data was computer coded in grams. Food intake was expressed in macro- and micronutrients using the MRC *Food Composition Tables* (Langenhoven et al., 1992b). Mean micronutrient intakes were expressed as percentages of the recommended daily allowance (RDA) (Food and Nutrition Board, 1989).

Descriptive data from the questionnaire and the 24-h dietary recall was generated by univariate and frequency analysis. The SAS package for the Unix environment was used for all analyses.

Results

Food production

All mothers purchased some food for the household from the local stores. Major food items that were usually bought are listed in Table 1. Food items frequently bought by more than 80% of the mothers included maize meal, rice, flour, dried beans, sunflower oil and sugar. Food items grown locally in either a home garden or a community garden are listed in Table 2. Seventy-five per cent of the mothers said that some food for the household was being produced locally. Only 9.5% of mothers indicated that food from the home garden was sold for cash. All mothers saw the main function of the home garden as being for daily food needs; 9.5% also saw it as a source of cash income.

Food preparation

Although 85.7% of the mothers had electricity available in the homes, 95% of mothers used wood as an energy source for food preparation. Paraffin (45.2%), electricity (38.1%), and gas (2.4%) was used occasionally for food preparation. Most of the children (84%) got their

Table 1. The percentage of mothers/caretakers who normally purchase certain major food items for the household

Mothers (%)	Food items
100	Maize meal, rice
90–99	Wheat flour, dried beans
80–89	Sugar, oil
70–79	Potatoes
60–69	Samp
40–49	Brick margarine, bread, non-dairy creamer, eggs
30–39	Meat, chicken, tea, cabbage
20–29	Cold drink, cooking fat, apple, fish (canned), biscuits, banana, potato crisps/'niknaks', tomatoes
10–19	Oranges, pear, grapes, sweets, onion, milk, salt, soft margarine
1–9	Soup, spinach, polony, butter, pumpkin

Table 2. Percentages of households who have access to locally grown food items through home and community gardens

<i>Food item</i>	Home garden (%)	Community garden (%)
Has a home garden or livestock	75.6	–
Has access to community garden	–	35.7
<i>Livestock</i>		
Cattle	41.5	4.8
Sheep	9.7	9.5
Goats	34.1	–
Donkey	2.4	–
Chickens	70.7	19.0
<i>Products of livestock</i>		
Eggs	65.8	19.0
Milk	19.5	4.8
<i>Fruits</i>		
Peaches	24.4	4.8
Pawpaw	19.5	4.8
Lemon	4.9	–
Naartjie	4.9	–
Guava	4.9	–
Apple	2.4	–
Mulberry	2.4	–
Orange	2.4	–
<i>Vegetables</i>		
Pumpkin	46.3	23.8
Imifino	46.3	26.2
Mealies	43.9	16.7
Cabbage	29.3	26.2
Carrots	19.5	26.2
Tomato	7.3	4.8
Onion	4.9	7.1
Potato	2.4	–
Beetroot	2.4	4.8
Turnip	–	4.8
Sugar cane	2.4	–

drinking water from taps. Only 26% used water from the river as a source of drinking water.

The percentage of mothers who frequently added either sugar and/or fat to food during preparation is shown in Table 3. Cooking oil (mainly sunflower oil) is used regularly when cooking. Salt is normally added during the preparation of most foods. Two-thirds of the mothers brought an empty salt packet, which suggested that only iodised salt was being used. The addition of extra salt to food after it has been prepared was not common (70% of the children never added extra salt to their food).

Only 2% of the children added extra salt without first tasting the food, while 28% of the children added extra salt only when needed.

Food preferences

A total of 62.7% of the mothers regarded meat, on its own or in combination with other food items, as the best food for the child. Half the children listed rice, either on its own or in combination with other food items, as their favourite (best liked) food. Rice dishes that were listed included rice and meat or meat curry, rice and chicken or chicken curry, rice and tomato curry, and rice and beans. Fourteen per cent of the children liked curried dishes best. Kentucky fried chicken was favoured by 6% of the children. Only one child (2%) considered a 'luxury' item as the best liked food when she listed chocolate. The most disliked food by the children (56% of the children) was phutu (a stiff porridge made from maize meal). Phutu is a traditional food and is eaten either on its own or in combination with other foods such as cabbage, imifino (a dark-green leafy vegetable), beans, potatoes, potato curry, and pumpkin.

Meal frequency

Eighty-six per cent of the children had something to eat before coming to school, usually bread and tea. Forty per cent of children reported that they regularly ate commercial snacks (e.g. potato crisps or 'niknaks' (a maize savoury snack)) during school hours. All children reported having lunch and supper. Food items usually eaten during these two main meals included a carbohydrate (starch) item mixed with either vegetables, meat or beans, and potatoes.

Food frequency

The percentages of children who either consumed certain food items at least 4 days per week, or seldom are shown in Table 4. Food items consumed regularly by most of the children included phutu, bread and potatoes. Snack foods, such as potato crisp 'niknaks' and sweets/chocolates were consumed regularly by more than 70% of the children.

Nutrient intake

The quantified dietary intake data is shown in Table 5. The reported energy intake was lower

Table 3. The percentage of mothers/caretakers adding either sugar and/or fat to various food items. The type of fat used during preparation is shown. The percentage of children eating these food items often (at least 4 days per week) is indicated

	<i>Sugar added (%)</i>	<i>Fat added (%)</i>	<i>Type of Fat (%)</i>	<i>Eaten often (%)</i>
Maize meal porridge	83.3	16.7	14.3 brick margarine 2.4 soft margarine	40
On bread	19.0	64.3	54.4 brick margarine 7.5 soft margarine 2.4 cooking fat	90
Potato	2.4	100	81.0 sunflower oil 16.7 cooking fat	80
Pumpkin	59.5	54.8	2.4 brick margarine 45.2 sunflower oil 4.8 cooking fat 4.8 brick margarine	22
Carrots	7.1	30.2	25.5 sunflower oil 4.7 cooking fat	6
Cabbage	2.4	97.6	90.5 sunflower oil 7.1 cooking fat	20
Imifino	2.4	100	88.1 sunflower oil 11.9 cooking fat	46
Rice and beans	0	87.8	73.2 sunflower oil 12.2 cooking fat 2.4 brick margarine	50

than the RDA, while protein intake was adequate. Protein was mainly of plant origin (3/4 plant protein versus 1/4 animal protein). Calcium intake was extremely low, with only one

child having an intake of more than 67% of the RDA. The intake of vitamins was low, except for folic acid. Bread was the largest contributor to total energy intake (Table 6). The second

Table 4. The percentage of children either eating certain food items at least 4 days per week, or seldom/never

<i>children (%)</i>	<i>Food items</i>
<i>Eaten at least 4 days per week</i>	
100	Phutu
90-99	Bread, biscuits/cookies
80-89	Tomatoes, potatoes
70-79	Mealie (corn), savoury snacks, sweets/chocolate
60-69	Eggs, rice, cold drinks
50-59	Rice and beans, soya, vegetables, fruit
40-49	Meat, chicken, imifino, apple, banana, maize meal porridge
30-39	Pear
20-29	Milk, polony, canned fish, vetkoek, maize and beans, cabbage, pumpkin, orange
10-19	Cooked porridge (other than maize meal), samp and beans, naartjie, paw-paw, peach
5-9	Liver, fish (fresh), carrots, sweet potato, avocado, grapes, guava, mango
<5	Green beans, peas, apricot, melon, watermelon
<i>Consumed seldomly or never</i>	
100	Breakfast cereals, pasta
90-99	Melon, watermelon, apricot, peas, liver
80-89	Cheese, yoghurt, cooked porridge (other than maize meal), guava, mango, sweet potato, green beans
70-79	Fish (fresh), avocado, naartjie
60-69	Milk, maize and beans, grapes, pawpaw, peach
50-59	Vetkoek, samp and beans

Table 5. Energy and nutrient intakes in children 10 and 11 years old ($n = 50$) as determined by a 24-h dietary recall. Values are given as both the median (plus 95% CI) and the mean (plus SD), as well as the percentage of the RDA

Nutrient		Median	95% CI	Mean	SD	Mean % RDA	Median % RDA	95% CI % RDA	<67% RDA (%)
Energy	kJ	7208	6720; 8987	7624	2215	86.8	83.4	72.4; 98.7	28
Total protein	g	47.6	43.4; 57.4	51.1	20.5	144.3	137.7	109.9; 158.2	4
Plant protein	g	34.8	31.7; 39.7	37.1	14.3				
Animal protein	g	10.6	6.0; 17.5	13.8	16.3				
Total fat	g	52.1	48.7; 62.3	57.9	22				
Saturated fat	g	15.4	13.4; 17.7	16.8	7.6				
MU fat	g	16.8	13.7; 19.2	18.2	9.5				
PU fat	g	17.9	14.7; 21.4	18.4	8.2				
Cholesterol	mg	69	36.3; 91.0	96	112				
Available CHO	g	257	230; 316	273	83				
Dietary fibre	g	18.7	16.1; 22.4	20.2	9.7				
Added sugar	g	31.7	22.9; 43.2	35.1	23.1				
PE-protein		10.6	9.9; 11.2	11.3	3.6				
PE-fat		29	26.4; 30.7	28.5	5.3				
PE-CHO		64.9	61.7; 67.9	64.7	7				
PS ratio		1.02	0.89; 1.26	1.25	0.68				
Calcium	mg	252	204; 343	282	152	29.1	25.8	19.8; 33.6	98
Iron	mg	11.9	11.0; 14.2	12.8	4.7	109.3	109.5	94.9; 119.7	14
Magnesium	mg	222	171; 263	229	86	106.2	99.6	87.7; 111.3	20
Zinc	mg	5.2	4.4; 6.1	5.7	3.4	50.4	44.2	35.3; 53.7	82
Vitamin A	RE	352	415; 517	558	364	71.9	59.9	52.5; 71.9	60
Thiamin	mg	0.81	0.67; 0.90	0.83	0.31	76.9	72.6	66.2; 85.5	42
Riboflavin	mg	0.83	0.44; 2.39	1.53	1.43	120.2	60.5	34.7; 174.1	52
Niacin	mg	7.11	6.21; 8.75	8.15	4.44	57	51.8	41.9; 66.7	66
Vitamin B ₆	mg	1.01	0.85; 1.31	1.12	0.56	77.1	71.1	56.8; 92.5	46
Vitamin B ₁₂	µg	0.65	0.39; 1.40	1.46	2.17	88.6	41.2	27.8; 70.0	62
Folic acid	µg	172	121; 221	206	141	170.5	146.2	93.3; 187.7	20
Vitamin C	mg	15.8	11.3; 18.0	19.6	17.9	41.5	33.6	24.4; 38.4	82

largest contributor was the 'smart cookie' – a fortified biscuit (fortified with β -carotene and iron) developed by the MRC and a food company (SASKO) that is presently being issued to the school children daily.

Discussion

Due to improved road conditions and transport system, the area is exposed more and more to the influences of nearby towns and cities. This is evident by the inclusion of fast foods such as 'Kentucky fried chicken' on the list of favourite foods. The listing of phutu as the most disliked food is an indication that food preferences of the youth in this rural area is moving away from the more traditional food items. Phutu is a traditional stiff porridge made from maize meal and is eaten either on its own or in combination

with other food items. Although disliked by more than half of the children, it is regularly consumed since maize meal is the most affordable food item in this community.

Several changes have taken place in the target area since a cross-sectional survey was conducted in 1994. In contrast with the 1994 results (Oelofse *et al.*, submitted) which showed that more than 80% of households obtained their drinking water from the river, now only 26% of the school children drank river water. Taps have recently been installed in the area, and although the community must pay for the water, most of the children (84%) reported having their drinking water from taps. This represents a vast improvement in the dietary intake of the children, since the river water was heavily polluted and as it was seldom boiled before consumption it posed a health risk.

Table 6. The frequency of food items reported in the 24-h dietary recall ($n = 50$), the mean, minimum and maximum portion sizes (in grams) as well as the percentage contribution of each food item to total energy intake

<i>Food item</i>	<i>Freq.</i>	<i>Mean</i>	<i>Min.</i>	<i>Max.</i>	<i>Energy (%)</i>
Bread	67	122	20	320	21.3
Smart cookie	47	45	45	45	9.7
Rice	42	135	40	325	8.0
Phutu	34	230	80	800	7.6
Dried beans	31	106	30	240	5.2
Niknaks	24	36	17	67	5.2
Sunflower oil	64	6	2	15	3.8
Sugar	62	14	4	30	3.7
Potato	37	104	8	280	3.6
Brick margarine	35	11	5	20	3.2
Vetkoek	6	121	25	320	2.9
Meat (beef)	8	120	50	210	2.6
Fish	23	45	30	120	2.4
Chips	3	241	200	300	2.4
Bunny lick/cold drink	34	246	50	750	2.4
Potato crisps	6	41	21	60	1.5
Polony	10	40	30	90	1.4
Sweets	27	12	5	70	1.4
Chicken	8	62	50	140	1.3
Chicken pie	3	100	75	150	1.2
Cookies	6	39	30	50	1.2
Fish pie	3	67	12	100	<1
Cooking fat	10	5	2	7	<1
Apple	6	130	125	150	<1
Pear	2	122	120	125	<1
Avocado	1	30	30	30	<1
Tomato	4	115	100	160	<1
Mealie	1	162	162	162	<1
Sausage	2	45	45	45	<1
Samp	3	142	112	193	<1
Maize meal porridge	5	265	150	430	<1
Ground nuts	1	10	10	10	<1
Ice cream	5	40	30	60	<1
Soft margarine	2	12	10	14	<1
Cabbage	3	120	51	192	<1
Tomato and onion mix	9	84	30	150	<1
Imifino	5	104	58	216	<1
Milk	1	10	10	10	<1
Non-dairy creamer	32	5	2	8	<1
Maas	1	110	110	100	<1
Eggs	4	50	50	50	<1
Mahewu	4	350	300	500	<1
Coffee	2	300	300	300	-
Tea	52	266	9	300	-

Although 80% of the mothers had access to electricity in their homes, wood was the main source of energy for cooking. A great concern is that often these open fires used for cooking are made within the dwelling.

In South Africa the iodization of salt became mandatory in 1995. Before 1995, iodised salt was not available in this community, which led to iodine deficiency of moderate severity (Benadé

et al., 1997). Three years after the introduction of mandatory salt iodization, only iodised salt was used by the mothers in this rural area. Salt is usually used in the preparation of most foods. Approximately a third of the children added additional salt to their food, but only if needed as determined by tasting the food first.

It has been shown that young children, especially those above grade 2, can give

comprehensive dietary information (Emmons & Hayes, 1973). For the 24-h dietary recall conducted on 10- and 11-year-old children in grades 4,5 and 6, mothers helped with specifying and quantifying food items that were unknown to the children, especially those used in recipes. Food items listed in the 24-h dietary recall and food frequency suggest that some families in the low socioeconomic category, spend relatively large amounts of money on foods and drinks with poor nutritional value, such as commercial savoury snacks, cold drinks and sweets. Taking into account that 38% of mothers borrowed food and 17% of mothers begged for food from time to time, the money spent on 'luxury' food items with low nutritional value could be used more sensibly for buying better quality food.

Food intake was limited to a small range of foods. The biggest contributor to energy intake was bread, either white, brown or homemade. The lack of variety of foods in their diet predisposed the children to low micronutrient intakes. The fat content of the diet was higher than reported for rural black people in South Africa (Steyn *et al.*, 1997). This could probably be attributed to the regular use of fat (mainly sunflower oil) in the preparation of foods. The regular use of sunflower oil in the preparation of food is reflected in the favourable P/S ratio of ± 1.2 .

A cross-sectional survey in 1994 (Oelofse *et al.*, submitted) showed this area to have a serious health problem of vitamin A deficiency. This prompted the initiation of the NRPNI biscuit programme (Van Stuijvenberg *et al.*, 1997), supplying the school children with fortified biscuits ('smart cookies'). These biscuits are provided to the children on school days. Despite most children reporting these biscuits during the 24-h recall, the median vitamin A intake was only 59.9% of the RDA. Considering that the biscuits provide approximately 50% of the RDA for vitamin A, the vitamin A intake by the children through foods other than the fortified biscuit was only $\pm 10\%$ of the RDA. Vitamin A rich foods, such as pumpkin and carrots did not feature prominently in the diet, in spite of the fact that many mothers had access to these food items, either from home or community gardens. Most mothers who had access to a home garden said that the importance of the home garden is the

supply of fresh fruit and vegetables. This was, however, not reflected in either the food frequency or the 24-h recall assessment. The low intake of fruit and vegetables, despite the presence of home gardens, stresses the importance of including education on efficient use of locally produced food items in campaigns promoting the development of home gardens.

Imifino, a locally produced dark-green leafy vegetable, is reportedly consumed more often than yellow vegetables such as pumpkin and carrots. Dark-green leafy vegetables have not been shown to affect vitamin A status, because of their low bio-availability (de Pee *et al.*, 1995). In the study of de Pee *et al.*, (1995), only 3% of the participants were vitamin A deficient which could have contributed to the lack of response. The role of dark-green leafy vegetables in combatting vitamin A deficiencies in communities regarded to have a vitamin A deficiency needs to be explored. The local production of imifino must not be neglected, but much more emphasis should be put on the production and consumption of yellow fruits and vegetables.

The importance of low intakes of fruits and vegetables in a community lies in its impact on micronutrient status. It has been shown previously (Kendal *et al.*, 1996) that the frequency of consumption of fruits, salads, carrots and vegetables and the household availability of all food categories, declined significantly as food insecurity status worsened. The effect of personal preferences and ignorance on the intake of specific food items, e.g. fruits and vegetables, should not be underestimated. Fruits and vegetables did not feature in the list of the children's favourite foods. The list of most disliked foods included cabbage (16%), imifino (12%), and pumpkin (8%).

The result of a very low intake of calcium is of concern. The food frequency data showed clearly that dairy products were only rarely consumed. Similar results were obtained previously (Oelofse *et al.*, submitted). A few mothers have access to locally produced milk, the amount and frequency of availability are, however, not known. Milk is not purchased on a regular basis from the local shop. Many children reported drinking tea with sugar and non-dairy creamers. Non-dairy creamers were bought regularly from the local shop by more than 40% of the mothers. The use of milk

powder, rather than non-dairy creamers, should be promoted. Milk powder (both skimmed and full cream) is available in the local shop. An obvious lack of knowledge, or personal preferences or price, rather than unavailability, is considered to be the reason for the use of non-dairy creamers instead of milk powder. The low calcium intake further stresses the importance of including crops, livestock and the products of livestock when promoting local food production.

A recent article in the *South African Medical Journal* (Steyn et al., 1997) stressed the importance of research focused on causes of food insecurity in order to carry out effective intervention programmes. The research should be multi-disciplinary and agriculturalists, health professionals and social scientists should work together to address the problem effectively. The MRC has made a major move in this direction.

Since the cross-sectional survey in 1994 was conducted in Ndunakazi, various intervention programmes were started (Benad et al., submitted) to address the nutritional problems in the area. The MRC sees a long-term solution in prioritising the development of targeted home gardens for most dietary and micronutrient needs in the future. The Department of Agriculture and the MRC are collaborating in an effort to develop effective ways of increasing local food production.

Acknowledgements—The authors would like to show their sincere appreciation to the nutrition monitors (Eunice Mhlongo, Lindiwe Msiya, Mthokozisi Khuzwayo and Derick Mkhize) and sister Tholani Madlala for interviewing the mothers and children; Angeline Ndlovu and Nhlanhla Hlophe for arranging the appointments; the headmaster of the Ndunakazi Primary School, Mr Michael Phungula, for his commitment to the programme; and the mothers and children for their participation.

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