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Assessment of Anthropometry, Nutritional Compositions and Contribution of School Meals to the Daily Nutrient Requirements of Primary School Children from Rural Communities

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ABSTRACT

The study aims to evaluate the nutritional status and influence of school meal intakes on RDA of primary school children in Akure community, Ondo State, Nigeria. A cross-sectional study was conducted among 728 primary school children aged between 6 and 15 years. Data were collected using interviewer-administered semi-structured questionnaires. The questionnaires collect information on demographic characteristics and home dietary intake of the subjects. The heights and weights of the children were measured using a standard procedure and height-for-age and weight-for-height z-score were determined. The children's school meal intakes were weighed for 4 days and samples were collected for chemical analysis. The results showed that 37.8% of the children were not wasted, 35.7% mildly wasted, 18.7% moderately wasted and 7.8% severely wasted. Also, 57.8% were not stunted, 29.3% mildly stunted, 11.0% moderately stunted and 1.9% were severely stunted. The subjects' home dietary intakes showed that 73.6% ate starchy food only, 19.9% ate protein based food, while 11.6% and 11.5% consumed fruits/vegetables and snacks to complement home meals respectively. The chemical composition of school meal was energy 379 − 413kcal, moisture content 5.9 − 7.3g, carbohydrate 56.5 − 69.4g, fat 4.6 − 12.7g, crude fiber 0.1 − 2.4g, ash content 3.6 − 8.5g and protein 14.9 − 22.3g. The mineral contents were calcium 45.9 − 59.2 mg, sodium 50.4 − 59.6mg, zinc 2.3 − 3.1mg, magnesium 55.0 − 61.6mg, potassium 55.3 − 69.3mg, copper 0.2 − 0.3 mg, while others 1.3 − 1.9mg, 243 − 659mg and 831 − 9,510mg were iron, phosphorous and vitamin-A respectively. The contribution of school meals to subjects' RDA was within 2.9% and 1540%. In summary, school meal intake contributed positively to the RDA and nutritional status of the school children. (*J Community Nutrition* 8(4): 171~176, 2006)

KEY WORDS: nutritional status · school meal · percentage contribution of school meal.

Introduction

Nutritional and health status are powerful influences on a child's learning and on how well a child performs in school. Children who lack certain nutrients in their diets (particularly iron and iodine), or who suffer from protein-energy malnutrition, hunger, parasitic infections or other diseases, do not have the same potential for learning as healthy and well-nourished children. Weak health and poor nutrition among school-age children diminish their cognitive development either through physiological changes or by reducing their ability to participate in learning experiences, or both (Carlo, Kevin 2001; Chang et al. 2002; GOK/UNICEF 1992; Ivanovic et al. 2000b; Liu et al. 2003). Poor nutrition and health among schoolchildren contributes to the inefficiency of the educational system (Braveman, Gruskin 2003; Maharaj et al. 2001). Children with diminished cognitive abilities and sensory impairments naturally perform less well and are more likely to repeat grades and to drop out of school than children who are not impaired; they also enroll in school at a later age, if at all, and finish fewer years of schooling. The irregular school attendance of malnourished and unhealthy children is one of the key factors in poor performance (Martorell et al. 1992; Merdez, Adair 1999). Even temporary hunger, common in children who are not fed before going to school, can have an adverse effect on learning. Children who are hungry have more difficulty concentrating and performing complex tasks, even if otherwise well nourished. Research and program experience

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show that improving nutrition and health can lead to better performance, fewer repeated grades and reduced drop out (Murphy et al. 1998).

The provision of nutritious meals at school to complement home food intake is an essential part of meeting daily nutrition needs and lowers their risk for chronic diet-related diseases for many school children, and also to improve school children concentration and ability to learn at optimal levels (National Dairy Council 2003; National Education Association 2003). Diet and nutrition are therefore the most important factors for proper growth, cognitive development, school performance and overall health status of children (FAO/WHO 1992; UNICEF 1990). Recent studies have established that poor physical growth and cognitive development in children are attributable to a range of factors closely linked to overall standards of living and the ability of population to meet their basic needs, such as access to good quality food, parasitic and infectious diseases (Ivanovic et al. 2002; Kerr et al. 2000; Mendez, Adair 1999; Pollitt 1993; WHO 1995), and that there is a strong relationship between impaired growth status and both poor school performance and reduced intellectual achievement (Akinadewo 1981; Martorell 1992; Nutrition, health and child development (NHCD) 1998).

The aim of this study, therefore, was to assess the contributions of school meal intake on the daily nutrient requirements of primary school pupils from rural communities of Akure North LGA of Ondo State.

Materials and Method

1. Study areas and design

A cross-sectional study was conducted among the primary school children in the rural communities of Akure North Local Government area of Ondo State. These rural communities inhabit over 85% of the total population of the local government area. The main occupation of the people in the community is farming in which nearly 90% of the working population is involved.

2. Subjects and data collection

A total number of 728 children (359 were females and 369 were males) were randomly selected for the study. The children aged 6 years and above, were randomly selected from five primary schools out of eleven primary schools in the rural communities of the local government areas.

Data were collected by means of interviewer-administered semi-structured questionnaires and the questionnaire was divided into three sections, i.e., demographic characteristics (sex and age,) and home dietary intake (using 24-hours dietary recall method).

3. Anthropometry assessment

1) Anthropometric measurements

Anthropometric measurements (heights and weights) of the children were measured by trained research assistants through standardized procedures (Gibbson 1990; Jellffe 1966; WHO 1983). Height was measured twice, to the nearest millimeter, with a portable direct reading stadiometer while the subjects were shoeless. Body weight was measured twice, with light clothing and shoes off, using a bathroom scale (Hana, Br-90011) to the nearest 0.1kg. The weight-for-height (wasting) and height-for-age (Stunting) z-scores were calculated. A validation study has provided support for the use of these nutritional indices in children and as one of the most appropriate nutritional indices for evaluating nutritional status of children (Waterlow 1977; WHO 1995).

2) Home dietary intakes

(1) Home meal

The dietary intake of the children at their respective homes was evaluated through 24-hour dietary recall method. Many studies have provided support for the use of 24-h dietary recalls in school children and as the most appropriate method for collecting dietary data from diverse cultural groups (Basch et al. 1990; Emmons et al. 1973; Johnson et al. 1996; Lytle et al. 1993; Lytle et al. 1998).

(2) School meal

The school meals intakes by the children were a self-sponsored program in which the school children were made to contribute a certain amount of money on a weekly basis towards the food. The school meal is usually taken between 11 : 30am and 12 : 15pm by the pupils every school day. The school meal was assessed via weighing and chemical methods.

(3) Chemical analyses

Some of the food samples were collected at each meal for proximate analysis, that is, for moisture, fat, protein (N × 6.25), crude fiber and ash in accordance with the procedures of AOAC (1995). Total lipids were estimated by petroleum ether extraction. Carbohydrate content was estimated by difference.

Gross energy was determined using a Gallenkamp Autobomb automatic adiabatic bomb calorimeter (London, UK). The total ash was estimated after ashing for 12h at 550℃. Calcium, sodium, zinc, magnesium, potassium, copper and iron contents were determined on ash sample using a Buck Model 200A flame atomic absorption spectrophotometer, while phosphorous content was determined using the vanadomolybdate method (AOAC 1995).

Statistical Analysis

Data were processed and expressed as the percentage of the population sample using SPSS 11.0 computer software and EPI-Info-version 6 computer packages. Results were expressed as mean values (X) and standard deviations (SD). The children's heights-for-age and weight-for-height z-scores were calculated.

Results

The result of demographic characteristics of the subjects showed that 50.7% of the subjects were males and 49.3% were females. The result also showed that 19.6% of the children belonged to the age group of 6 − 8 years old, 33.8% were within the age of 9 − 11 years old, and while others 37.1% and 9.5% were within the age group of 12 − 14 and 15 years and above respectively (Table 1).

Table 1. Demographic characteristics of the subjects

	Male	Female	Total
Parameters	%	%	%
Gender	50.7	49.3	100
	Age (years)		
6 − 8	18.97	20.3	19.6
9 − 11	31.70	36.0	33.8
12 − 14	33.87	40.4	37.1
15 +	15.44	3.3	9.5

Table 2. Classification of nutritional status of the subject

A) Using weight-for-height index

	Male		Female		Total	
Classification	N	%	N	%	N	%
Normal	150	40.7	125	34.8	275	37.8
Mildly wasted	140	37.9	120	33.4	260	35.7
Moderately wasted	52	14.1	84	23.4	136	18.7
Severely wasted	27	7.3	30	8.4	57	7.8

B) Height-for-age index

	Male		Female		Total	
Classification	N	%	N	%	N	%
Normal	213	57.9	208	57.8	421	57.8
Mildly stunted	105	28.5	108	30.0	213	29.3
Moderately stunted	43	11.7	37	10.3	80	11.0
Severely stunted	7	1.9	7	1.9	14	1.9

The subjects were classified into different nutritional status using weight-for-height and height-for-age nutritional indices. Using weight-for-height nutritional index, the distribution showed that 37.8% of the children were normal, 35.7% were mildly wasted, 18.7% moderately wasted and 7.8% were severely wasted. The height-for-age distribution results showed that 57.8% of the subjects were not stunted, 29.3% of the subjects were mildly stunted, 11.0% moderately stunted and 1.9% were severely stunted (Table 2A and B).

The school meal and home dietary intakes of the subjects were assessed using 24-hours dietary recall method, weighing methods and chemical analysis. The result of home dietary intakes of the children showed that 73.6% of the children

Table 3. Dietry intakes

A) Home dietary intake (using 24-hours dietary recall method)

Type of meal	Starch based food		Protein based food		Vegetables		Snacks	
	N	%	N	%	N	%	N	%
Breakfast	552	75.82	173	23.76	93	12.77	67	9.48
Lunch	502	68.90	121	16.62	78	10.71	98	13.36
Supper	554	76.09	140	19.23	82	11.26	85	11.68

B) Chemical composition of 100g of (dried weight) school meal samples

Composition	Day 1 SMI	Day 2 SMI	Day 3 SMI	Day 4 SMI
Energy (kcal)	379	390	413	412
Moisture content (g)	7.3	6.0	5.9	5.9
Carbohydrate (g)	69.4	58.5	56.5	57.0
Fat (g)	4.6	7.8	12.7	10.5
Crude fibre (g)	0.1	0.8	2.4	1.3
Ash content (g)	3.6	5.4	4.10	8.5
Crude protein (g)	14.9	21.4	18.3	22.3
Calcium (mg)	55.9	59.2	53.7	45.9
Sodium (mg)	58.0	50.4	54.3	59.6
Zinc (mg)	3.1	2.3	2.6	2.8
Magnesium (mg)	61.6	55.0	57.6	56.8
Potassium (mg)	69.3	55.3	60.7	66.2
Copper	0.3	0.2	0.3	0.3
Iron (mg)	1.6	1.7	1.9	1.3
Phosphorous (mg)	243	659	659	143.5
Vitamin A (μg/d)	9510	9510	9510	831

SMI: School meal intake

Table 4. Percentage contributions (C) of school meal (SM) intake to recommended daily allowance (RDA) of the subjects

Attributes	6 years			7 – 10 years			11 – 14 years			15 – 19 years		
	RDA	SM	%C	RDA	SM	%C	RDA	SM	%C	RDA	SM	%C
						Boys						
Energy (MJ)	6.5	3.6	55.4	8.1	3.6	44.4	11.3	3.6	31.9	11.8	3.6	30.5
Protein (g/d)	19	42.2	222	34	42.2	124	52	42.2	81.2	52	42.2	81.2
Fiber (g/d)	25	2.3	9.2	31	2.3	7.4	38	2.3	6.1	38	2.3	6.1
Calcium (mg/d)	800	117	14.6	1300	117	9.0	1300	117	9.0	1300	117	9.0
Sodium (μg/d)	1.2	0.12	10.0	1.5	0.12	8.0	1.5	0.12	8.0	1.5	0.12	8.0
Zinc (mg/d)	5	5.3	112	8	5.6	70.3	11	5.6	51.1	11	5.6	51.1
Magnesium (mg/d)	130	122	94	240	122	50.9	410	122	29.8	410	122	29.8
Potassium (g/d)	3.8	0.13	3.4	4.5	0.13	2.9	4.7	0.13	2.8	4.7	0.13	2.8
Copper (μg/d)	440	620	141	700	620	88.6	890	620	69.7	890	620	69.7
Iron (mg/d)	10	3.5	35.2	8	3.5	44	11	3.5	31.8	11	3.5	31.8
Phosphorous (mg/d)	500	586	117	1250	586	46.9	1250	586	46.9	1250	586	46.9
Vitamin A (μg/d)	400	7702	1925	400	7702	1925	500	7702	1540	600	7702	1540
						Girls						
Energy (MJ)	6.5	3.6	55.4	8.1	3.6	44.4	8.9	3.6	31.9	9.0	3.6	30.5
Protein (g/d)	19	42.2	222	34	42.2	124	46	42.2	81.2	46	42.2	81.2
Fiber (g/d)	25	2.3	9.4	28	2.3	7.5	28	2.3	6.2	28	2.3	6.1
Calcium (mg/d)	800	117	14.6	1300	117	9.0	1300	117	9.0	1300	117	9.0
Sodium (μg/d)	1.2	116	9.7	1.5	0.12	7.8	1.5	0.12	7.8	1.5	0.12	7.8
Zinc (mg/d)	5	5.6	112	8	5.6	70.3	9	5.6	51.1	9	5.6	51.1
Magnesium (mg/d)	130	122	94	240	122	50.9	360	122	29.8	360	122	29.8
Potassium (g/d)	3.8	129	3.4	4.5	129	2.9	4.7	0.13	2.8	4.7	0.13	2.8
Copper (μg/d)	440	620	141	700	620	88.6	890	620	69.7	890	620	69.7
Iron (mg/d)	10	3.5	35.0	8	3.5	44	15	3.5	31.8	15	3.5	23.5
Phosphorous (mg/d)	500	586	117	1250	586	46.9	1250	586	46.9	1250	586	46.9
Vitamin A (μg/d)	400	7702	1925	400	7702	1925	500	7702	1540	600	7702	1284

RDA source: Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, amino acids and micronutrients (1998/2000/2002/2005). www.nap.edu

consumed starch based food on a daily basis, 19.9% of the subjects were able to supplement their diets with protein based food, while fruits and vegetables form part of 11.6% dietary intakes and 11.5% ate snacks to complement their daily dietary intakes (Table 3A). The chemical composition of school meals showed that energy values ranged between 379 – 413 kcal, moisture content 5.9 – 7.3g, carbohydrate 56.5 – 69.4g, fat 4.6 – 12.7g, crude fiber 0.1 – 2.4g, ash content 3.6 – 8.5g and protein 14.9 – 22.3g, and while the mineral contents ranges between calcium 45.9 – 59.2mg, sodium 50.4 – 59.6mg, zinc 2.3 – 3.1mg, magnesium 55.0 – 61.6mg, potassium 55.3 – 69.3mg, copper 0.2 – 0.3mg, while others 1.3 – 1.9 mg, 243 – 659mg and 831 – 9,510mg were iron, phosphorous and vitamin A respectively (Table 3B).

Table 4 shows the mean energy intakes, nutrient intakes and percentage contributions of the school meal to the recommended daily allowances (RDA) of the subjects. It was observed that the percentage contribution of school meal intakes to the RDA of the children ranged between 2.9% to 1540%.

Discussion

The dietary intakes of the subjects were generally poor. A large proportion of the subjects were living on carbohydrate foods, such as cassava, cereal, yam, etc., with low protein, fruits and vegetables intakes. This poor feeding habit could be attributed to socio-cultural factors and also poverty, which is highly prevalent among the rural communities. Many scientific studies have reported that children belonging to the poor families were usually malnourished, had poor academic performance and reduced intellectual achievement due to lack of access to food, poor feeding practices and health care (Adekunle 2005; Cole et al. 1997; Ijarotimi, Oyeneyin 2005; Mar-

torell et al. 1992; Mercedes et al. 2000).

It was observed in this study that almost half of the children were stunted and two-thirds were underweight. This finding could be attributed to the recent economic restructuring that the country is undergoing, which negatively affects the purchasing power of many families, also, increased prices of many staple foods. Besides, in Nigeria, especially among the Yoruba ethnic group where the present study was conducted, the staple diet consists mainly starchy foods, such as yam (boiled or pounded or amala), cassava (Manihot esculenta) flour (lafun or gari), maize, etc., and that these local foods are low in protein content to meet protein requirements of these children. This observation was similar to other findings, which had early on reported that there were strong associations between dietary intakes and socio-economic status and cultural factors (Cole, Ogungbe 1987; Cole et al. 1997; Ishara, Jeevika 2005; Paula, Sofia 2003).

School meal programs have been initiated in many countries. Most of these programs have three main objectives, i.e., to improve school attendance, academic performance, and the nutritional status of the children. In this study it was observed that the daily school meal intake by the school children contributed certain percentages to the children's RDA, for instance, in some of the nutrient requirements the school meal contributed up to 30.0% and above of the children's RDA. This finding supported the objectives of introducing school meal programs into primary schools, particularly those children from rural communities. Many scientific studies had reported on the positive contributions of school meals in improving the nutritional status, school enrollment and attendance, learning abilities, school performance, fewer repeated grades and reduced drop out of school children (Kleinman 1998; Partnership for Child Development 1997; Politt 1995; Sigman et al. 1989; Simeon, Grantham-McGregor 1989; Worobey, Worobey 1999).

Conclusion

This study established that school meals in schools contributed to the improvement of nutritional status and recommended daily intakes (RDA) of school children, particularly those school children from a rural community where a large proportion of the families are poor.

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■ **Ethical issues**

The study protocol was approved by the Ethics Committee of the Human Nutrition Division of Federal University of Technology, Akure, Nigeria.

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