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Assessment of Macronutrient Content in Lunch Meals of Some Selected Preschools in the Cape Coast Metropolis of the Central Region of Ghana

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Abstract

The study was to assess the macronutrient content in lunch meals of some selected preschools in the Cape Coast Metropolis of the Central Region of Ghana and determine whether these macronutrient content meet the World Health Organization recommended daily intake for children. The study considered the meal pattern in the selected schools, whether the macronutrient content of the meals served meet the WHO RDI for children's lunch meals and how the meals is were funded. The research design for the study was a descriptive survey. The target population for the study was made up of all private pre-schools in the Cape Coast Metropolis which provide lunch meal for the children and the simple random sampling technique was used in the selection of respondents. To obtain data, questionnaires, and laboratory tests of food samples were used. The data collected in this study was checked, coded and statistically analyzed using the Statistical Package for Social Science (SPSS) version 17.0. It was found that all the dishes served to the children belonged to the group of cereals, grains and starchy root. The findings indicated that the protein, carbohydrate, and fibre contents of the meals did not meet the recommended intake by WHO.

Keywords: macronutrient, Recommended Daily Intake (RDI), lunch meals, nutrients.

1. Introduction

The early years of life is a period of very rapid growth. Appropriate nutrition is essential during this period for good health and proper development. Children who do not receive sufficient energy and nutrients will not sustain their expected growth and development and may result in malnutrition. Malnutrition is a worldwide problem and plays an important role in the health and welfare of individuals. It may result in morbidity, poor academic performance and fewer opportunities for economic development (Wardlaw & Kessel, 2002).

"We are what we eat" is a statement frequently used to express the view that the composition of our bodies is dependent to a large extent on what is eaten. Latham (1997) states that, "many factors determine an individual's need for nutrient, including body size, rate of growth, physical activity, basal energy and expenditure". No one nutrient, or group of nutrients, is any more important than others; children need dozen of nutrients that function collectively to encourage growth and development. The nutrient needs of children can be grouped under two broad headings: macro and micro nutrients. Macronutrients constitute the majority of an individual's diet, which supplies energy, essential nutrients that are needed for growth, maintenance and activity. Micronutrients on the other hand are the nutrients or minerals that are required by humans and other living organisms throughout life in small quantities to orchestrate a whole range of physiological functions, but which the human itself cannot produce (UNICEF, 2006). Macronutrients such as protein, carbohydrates, fats and oils are used interchangeably as sources of energy with fats and oils yielding nine calories per gram, protein and carbohydrate each yielding four calories per gram.

Protein, as noted by Schucler (1982) is chiefly composed of large combination of amino acids containing the elements carbon, hydrogen, nitrogen and oxygen and is the major source of building materials for muscles, bones, hair, nails and internal organs. Once ingested, protein is broken down into amino acids. Currently there are 22 amino acids that have been identified as vital for growth, development and maintenance of health. Of the 22 amino acids nine are essential, and therefore must be derived from food sources, while the remaining 13 are non-essential and can be synthesized by the body and are therefore referred to as non-essential amino acids.

In Burton and Foster's (2000) submissions, protein can also be further classified as either complete or incomplete. Complete protein sources such as meat, poultry, fish, eggs, milk and cheese contain all of the nine essential amino acids, while sources such as nuts and legumes lack some of the essential amino acids and are therefore considered incomplete. According to Salen and Ore (1990), proteins provide calories but also serve a more important and complex function, therefore an adequate intake of protein is essential if normal growth is to occur. Lack of it results in kwashiorkor, marasmus and other related diseases. Bonnie and Sue (1996) also add that protein needs of children include those for maintenance of tissue, changes in body composition and synthesis of new tissues. They estimate that protein needs for growth range from 1-4g/kg of tissue gained. Toddlers (one and two years old) still have a lower growth rate, averaging from 1-2kg each year. As a result of this significant slow down in growth, their protein needs for growth decreases as the rate of growth declines. To Burton and Foster (2000), as children grow older and accept table food, they receive additional foods that provide high quality protein.

Carbohydrates are composed of carbon, hydrogen and oxygen and constitute the main source of energy for all body functions, particularly brain functions (Eppright, 1997). In Davies' (1999) opinion, carbohydrates are the easiest form of food for the body to be converted into energy. Once ingested, carbohydrates are turned into glucose in the bloodstream and later into glycogen which is stored in the liver and muscle for later use.

Carbohydrates are chiefly divided into three different chemical classes, monosaccharides, disaccharides and polysaccharides. Monosaccharides are the single sugars, otherwise referred to as simple carbohydrates. Disaccharides are double sugars and are also referred to as simple carbohydrates. Polysaccharides are multiple sugars, otherwise referred to as complex carbohydrates. Simple carbohydrates (monosaccharide and disaccharides), like those found in fruits, break down very rapidly in the body, making them a good sources of quick energy. Complex carbohydrates (polysaccharides) like those found in unpolished rice, potatoes and pasta, take longer to break down in the body, and provide a more even distribution of energy over a longer period of time.

According to Martin and Kern (1992), carbohydrates are the principal sources of dietary energy and act as protein "sparers", so that protein can be used for its primary functions. Pipes and Trahms (1993) also assert that carbohydrates supply between 40 % and 50% of the energy consumed by most infants. Complex carbohydrates are the most important dietary carbohydrate sources. Davies (2002) argues that foods such as candies, cookies and potato chips, for example, provide primarily calories, whereas whole cereals and grains are important sources of the B vitamins as well as carbohydrates. Careful attention to the nutrients carried by the carbohydrate containing food is therefore important in planning diets of children. Indiscriminate consumption of candies, cookies, carbonated beverages and other sweetened drinks dulls the appetite for nutrient-rich foods, contributes to overweight, dental caries and general poor nourishment in infants and young children and should be discouraged.

Fats and oils, like carbohydrates, are composed of carbon, hydrogen and oxygen. However, in fats, the elements are connected together differently than in carbohydrates. Fats can be found in both plants and animals, and are insoluble in water (Engle & Ricciuti, 1995). Fats provide three primary functions. They are the major source of stored energy for the body, they serve to cushion and protect the major internal organs and they act as an insulator, preserving body heat, and protecting against excessive cold. Wardlaw (2000) explains that once ingested, fats are broken down into fatty acids and glycerol and are divided into different categories. These are simple fats (triglycerides), compound fats (phospholipids, glucolipids and lipoproteins) and derived fats (cholesterol).

According to Burton and Foster (2000), fats are used by the liver to manufacture cholesterol. Cholesterol is a member of lipids called sterols and is found only in animal tissues. Cholesterol is important in that it acts as a precursor for the synthesis of various steroid hormones in the body. However, King and Burges (1995) substantiate that polyunsaturated fats can lower both low density lipoprotein cholesterol (LDL, bad cholesterol), as well as lowering high density lipoprotein cholesterol (HDL, good cholesterol). Burton and Foster (2000) further state that polyunsaturated fats can be found in foods like almonds, peanut, sunflower oil, corn oil, fish, mayonnaise, soybean oil, walnuts and most margarine.

Unsaturated fats, on the other hand, can lower LDL's without affecting ones HDL's making them the healthiest of possible fat sources in the diet. Unsaturated fats can also be found in foods such as pear, cashew, olive oil, and groundnut oil. According to Worthington-Robert and Williams (1996), fats supply between 40 and 50% of the energy consumed in infancy and approximately 40% of the energy consumed after infancy. Fats are calorically concentrated and therefore, may be very important in the diet of children who are lean and physically active and

have small appetites, or in the diet of children with oral motor problems who can consume only a limited volume of food. Chunky passive children should limit the quantity of fat consumed to keep away from gaining weight too rapidly.

The importance of a balanced diet, especially for children cannot be overemphasized. Many children fall ill because of lack of proper nutrition. For this reason it is vital that children receive the proper nutrition through the foods they eat. Taking into consideration the time children spend at preschool centres, Landers, Warden, Hunt and Boulton (1994) suggest that whatever children are fed on in the various preschool centres should meet at least 50% of the child's total Recommended Daily Intake (RDI). According to Landers et al. the 50% of the RDI to be met by the preschool centres should include main meal and two snacks. The rest of the 50% should then be met by parents or guardians at home during the child's breakfast and supper. It is therefore important to note that if as much as 50% of the child's total food intake is attributed to lunch meal alone, then it is imperative to recognize that lunch meals play a vital role in a child's life. It is therefore clear that out of home child care centres have a remarkable impact on the foods and nutrients provided to young children. Though nutrition standards for day-care programmes have been enacted by the Social Welfare (2003), the question still remains whether preschools provide adequate nourishment for children.

2. The Purpose of the Study

The study was to assess the macronutrient content in lunch meals of some selected preschools in the Cape Coast Metropolis of the Central Region of Ghana and determine whether these macronutrient content meet the World Health Organization recommended daily intake for children.

3. Research Questions

The following research questions guided the study.

i. What is the meal pattern in the selected schools?
ii. Does the macronutrient content of the meals served meet the WHO RDI for children's lunch meals?
iii. How is the lunch meals funded?

4. Significance of the Study

Generally, the study is expected to provide information on the macronutrients content of lunch meals of preschool children in the Cape Coast Metropolis. Specifically, the study brings to the fore useful information needed by stakeholders such as parents, heads of preschools, Ministry of Education and other interested bodies on the need to provide nutritious meals for children in the schools. Again, if the recommendations made by the study are implemented by the stakeholders such as heads of preschools and the government, it will serve as a check or guideline for the preschool meal providers to combine food stuffs that are rich in essential nutrients. For the heads of schools it will provide insight on the nutritional needs of children and how best they can meet those needs and for parents, it will inform them on the need to meet the nutritional deficit created at school to enable their children stay healthy. It will further serve as a basis for conducting similar studies in other parts of the country and also open other areas for further research.

5. Research Design

The research design for the study was a descriptive survey. Denscombe (2007) observes that the notion of a survey suggests that the researcher intends to get information "straight from the horse's own mouth" and is purposeful and structured. It also enabled the researcher to gather enough data to determine the nature of the group studied as it existed at the time of the study. The strategy also allowed the use of questionnaire and observation guide which enabled the researcher to analyze the data statistically. The descriptive survey again aided the researcher to describe and document the nutrient content of the lunch meals that were provided by the schools. MacMillan (1996) concurs by stating that the use of the descriptive design is a report of the way things are, what is or what has been.

Thus, this approach was appropriate since not much work has been done to find out the macronutrient content of lunch meals served by preschools in the Cape Coast Metropolis. The descriptive survey research design was considered the most appropriate for assessing the quality of lunch meals given to pre-school children in the Cape Coast Metropolis.

6. Population

The target population for the study was made up of all private (individually owned) pre-schools in the Cape Coast Metropolis which provide lunch meal for the children. The private preschools were 21 in number with a

total population of 1562. Eight preschools were sampled out of the 21 preschools for the study. The study did not cover the public preschools because government owned preschools do not provide lunch meals for its preschoolers now. The provision of lunch meals for Government owned preschools is yet to be implemented.

7. Sample and Sampling Procedure

The simple random sampling technique was used. This technique was used to select the eight preschools out of the 21 private preschools that serve lunch meals in the Cape Coast Metropolis. Names of all the private preschools in the Metropolis were collected and each name was assigned a number on a slip of paper and folded. The slips of paper were then dropped in a bag and shaken vigorously. A slip of paper was removed from the bag without looking into it. The number on each slip of paper was recorded and used to check the corresponding preschool. Thus, the schools that were picked formed part of the study.

8. Research Instruments

To obtain data pertinent to the research, questionnaires, and laboratory tests of food samples were used.

9. Collection, Treatment and Analysis of Food Samples

Food samples were randomly collected from tables within the schools studied. Portions of the lunch meals served to the children were collected while children were at dining for a period of four weeks in each of the selected schools as recommended by Shils and Young (1986). The lunch meals collected from the various schools were kept in food containers, allowed to cool and covered with tight fitting lids which prevented spilling. All the small bowls used for the collection of the food were labeled and kept in a basket which was pitted with holes to allow fresh air to circulate around the food. The food was carefully transported in a vehicle to the laboratory. The food collected on daily bases was sent to the laboratory on daily bases for the entire period. Weights of both main dishes and accompaniments were recorded. Based on the consistency of dishes, food samples were dried and blended before the actual chemical analysis.

In this study the reliability of results that were obtained depended a great deal on the accuracy of the chemical analysis performed on the food samples obtained. Sub-samples of respective food samples were taken for dry matter and ash determination following procedures recommended by Association of Official Analytical Chemists (AOAC, 1990). The method generally used for the determination of moisture in the food samples was the measurement of the loss of weight due to drying at temperature of 105^{o}C. (Stewart, Grimshaw, Parkinson & Quarmby, 1974).

9.1 Determination of Carbohydrate

Soluble carbohydrate was determined using the anthrone method as outlined by Stewart et al. (1974). In the procedure, 50mg of the ground food sample was gently simmered on a hot plate for two hours. The sample was allowed to cool and filtered. Aliquot (part of the filterate) and standard solutions were taken through colour development and the absorbances of the samples and standards were determined using a spectrophotometer. The concentrations and the absorbances of the standard solutions were used to plot a standard curve from which the concentrations (C) of the samples were extrapolated (Stewart et al, 1974).

$$\text{W/w Carbohydrate (\%)} = \frac{\text{C(mg)} \times \text{extract volume (ml)}}{10 \times \text{aliquot} \times \text{sample wt (g)}}$$

9.2 Fibre Determination

The standard crude fibre procedure used was the one described in Association of Official Analytical Chemists (1990) handbook. In the procedure an amount of the milled food sample was weighed and extracted with ether for 6 hours to remove oil. An amount of the residue was then weighed and boiled successively with 1.25% sulphuric acid and 1.25% sodium hydroxide to remove all digestible components. The indigestible components were dried in an oven, weighed and ashed in a furnace. The difference between the oven dry weight and the ash constituted the fibre content.

9.3 Protein Determination

The determination of protein employed the kjeldahl method which consists of three main processes namely, digestion, distillation and titration. In the process of digestion a known weight of the milled sample was taken and 4.4ml of the digestion mixture added to it and digested for 2 hours at a temperature of 380^{o}C on a kjeldahl digestion bloc. The digestion mixture was prepared by adding 0.42g selenium powder and 14g lithium sulphate to 350ml hydrogen peroxide and mixed well. The mixture was carefully added to 420ml of conc. sulphuric acid. After the digestion, an aliquot (a part) of the diluted digest was taken for distillation. The distillate was titrated against HCL for the nitrogen content of the sample. The percent nitrogen obtained was multiplied by a factor of 6.25 to obtain the percent protein in the food sample (Stewart et al., 1974).

10. Data Analysis

The data collected in this study was checked, coded and statistically analyzed using the Statistical Package for Social Science (SPSS) version 17.0. For the nutrient components, weights of lunch (dry matter basis) were multiplied by their respective nutrient components to obtain quantities of nutrients supplied. The weights of the respective lunches per week was pooled together and divided by four to obtain the mean daily nutrients served at lunch in the schools studied. The data was presented mainly in tables of frequencies and percentages. Hypothesis formulated was tested using the inferential statistic. Specifically, the independent sample t-test statistics was used to determine whether there were any statistical differences between the World Health Organization's RDI for preschool children.

Further, descriptive statistical tools such as percentages, frequencies and the mean were used in the analysis of the data collected. MacMillan (1996) agrees that descriptive study simply describes and provides an understanding of a phenomenon usually with simple descriptive statistics and it is particularly valuable when an area is first investigated.

11. Results and Discussion

The data collected were analyzed and presented in order of the research objectives.

1. What is the meal pattern in the selected schools?
2. Does the macronutrient content of the meals served meet the WHO RDI for children's lunch meals?
2 How is the meals funded?

11.1 One Week Lunch Meal Pattern for the Selected Schools

To this research question, a check list of meals served as indicated in Table 1 was used to find out the weekly meal pattern for the selected schools.

Table 1 focuses on the weekly meal Examination. It indicates that three schools out of the eight schools fed the children with tomato sauce and boiled yam, two schools gave jollof rice with beans. Beans stew and fried plantain was served by two other schools with the remaining school serving beans stew and boiled rice as lunch on Mondays.

On Tuesdays, two schools offered tomato sauce with fish and boiled rice while three schools offered palava sauce and boiled rice. A school served beans and gari with the other two schools serving beans stew and boiled rice respectively. Three schools served beans stew and boiled rice on Wednesdays. Three schools served tomato sauce with rice, beans and gari and beans with fried plantain respectively. The two remaining schools served beans stew and boiled rice.

The data presented in the table also shows that, on Thursdays two schools offered palava sauce and boiled yam, followed by the three schools serving fish stew and spaghetti. Palm soup with rice balls was served by two schools with the remaining school serving beans and fried plantain. On Fridays, palm soup with banku, palm soup with rice balls, jollof rice with fried fish, 'palava' sauce with rice and beans stew with fried plantain were the dishes served in these preschools studied.

Table 1: Meal Pattern (Lunch) of the Selected Schools

Meals/Dishes	Monday	Tuesday	Wednesday	Thursday	Friday
Tomato sauce and rice	3	2	1	-	1
Jollof rice with beans	2	-	2	-	1
Palava sauce and boiled yam	-	-	-	2	-
Palava sauce and boiled rice	-	3	-	-	2
Beans and gari	-	1	1	-	-
Beans stew and fried plantain	2	-	1	1	1
Palm soup and rice balls	-	-	-	2	2
Beans stew and rice	1	2	3	-	-
Fish stew and spaghetti	-	-	-	3	-
Palm soup and banku	-	-	-	-	1

All the dishes served to the children belonged to the group of cereals, grains and starchy root. This may attest to the fact that these group of foods were readily available, relatively cheaper, easy to prepare and did not need any special equipment and skill. Again, these food groups were given to the preschoolers because they were considered suitable and appropriate, easy to chew and easily digestible. Furthermore, the preschools selected their choice of food from cereals and grains and starchy roots and plantain since they were the staple foods found within the area of study which is Cape Coast Metropolis. Hence these were most familiar foods that had been introduced to the children by their parents. According to Brigges (1994), most children eat foods which they are familiar with more easily. This assertion again is confirmed by the study conducted by Ndure (1999) on the nutritional needs of preschool children which revealed that a child's food choice preference was largely determined by the family environment and other community or external factors. Thus, the food choices seen in the schools conformed to general assertions made by the researchers.

With regards to the combination of meals, the results revealed that all the preschools within the study area served the type of combinations that were acceptable by the preschool children. For instance, "nkontomire" (cocoyam leaves) stew or 'palava' sauce and boiled yam, tomato sauce and kenkey; palm soup and rice balls as identified by the research, indicated a good balance in terms of food texture and colour. This fulfills contribution made by Eppright (1997) that dried foods are especially hard for preschool children to eat therefore one should ensure a balance of dry foods with one or two moist foods.

A critical examination of the weekly meal pattern provided by the preschools showed that, lunch was the only meal given to the children. This indicated that none of them served breakfast, snack or supper. This could be due to the fact that, money paid by parents was not sufficient to cater for a full day's meal for the children at school. These notwithstanding, preschools that feed the children are responsible for 50% of the nutrient intake for the

period they spend at school (Landers et al. 1994). The rest of the 50% is expected to be met at home during breakfast and supper.

11.2 Comparison of macronutrient content of meals served with the WHO RDI for children's lunch meals

Table 2: Results on Nutrient Content

Nutrient	N	Mean	Std. Dev.	Mean Diff.	Sig. Value
Protein	8	9.10	1.36	-2.90	.001
CHO	8	45.22	6.47	-19.78	.000
Fibre	8	0.78	0.17	-8.72	.000

The mean value of the protein content served in all the schools was (M=9.10, SD=1.36) whereas the test value was 12, t(7) = -6.05, p = .001(5% level of significance). A comparison of the mean protein value of 9.1 with the World Health Organization (WHO) standard value of 12 indicates that there is a mean difference of -2.9. This shows that the protein content in the lunch meals served to the children fell below the recommended levels as established by WHO.

Again the use of the t values presents a p value of .001 which falls below the 5% significance level. It can therefore be asserted that there is a significant difference between the World Health Organization's recommended protein level and the level of protein served to the children in the schools. Unfortunately however, the difference falls far below the recommended level. This therefore, implies that the children in the schools studied may have a protein deficit for that period of time, and if these are not provided in the other meals taken at home, then the children may stand the risk of stunted growth, poor development and health maintenance (Schucler, 1982).

For Carbohydrate, the average mean served for the week was (M = 45.22, SD = 6.47) while the test value was 65, t (7) = -8.65, p =.000 (5% level of significance). Comparing the mean carbohydrate value of 45.21 with the WHO recommended value of 65 shows a mean difference of -19.78. This demonstrates that the carbohydrate content served to the children was again below the recommended intake by WHO. As indicated earlier by Eppright (1997), carbohydrate constitutes the main source of energy for all body functions, particularly brain functions. Therefore, the inadequate levels of carbohydrates served to the children could in effect bring about less energy for all body activities and also hinder the proper functioning of the brain of the children.

Fibre provided for the children during the week in the schools (M = .78, SD = .17) was statistically significant compared with the recommended WHO fibre value of 9.5. The hypothesis at t(7) = 147.83, p = 000 was therefore rejected indicating that the fibre content of the meals provided for the children in the various schools studied was below the WHO fibre value. The low levels of fibre intake could result in other related illness such as colon cancer and constipation.

11.3 Funding of School Meals

Information gathered from all the eight preschools indicated that all the children were fed; implying that at least none of the children went home without lunch. Further investigation on how the feeding was funded revealed that the feeding was solely funded by parents. The reason being that, no fund was provided by the government to support the feeding of the preschool children. The government's non-involvement, however, contradicts how school feeding was organized years ago as reported by the British Parliamentary Papers. For instance, in England, charitable organizations and private individuals were responsible for the funding of meals for preschoolers.

The cost of feeding per child was GH ¢ 1.00 within the schools studied. Probing further to ascertain whether the money paid was adequate, seven out of the eight schools, responded that the money paid was not adequate. The respondents' argument was that GH ¢ 1.00 was not enough to cater for a well-balanced and nutritious meal per lunch. This implied that the schools were aware that the children were not receiving adequate nourishment from the meals served.

The seven schools, whose heads stated that money provided was not enough, explained that they supplemented the feeding with school funds which obviously led to adverse increase in children's school levies. On the other hand, the remaining school explained that they reduced the quantity of the food given to the children. This may imply that, the preschoolers were likely to be underfed, which could consequently defeat the intended purpose of feeding the children. This is in line with the assertion by Brigges (1994) that the dietary patterns of children are largely determined by economic factors. Here economic factors seemed to have affected the quantity or size of the meals because if money paid by parents was not enough to cater for the meals given these children, they were likely to be fed on food that was insufficient in quantity and quality

12. Conclusions

The conclusions drawn from the findings about the assessment of macro nutrients and mineral elements content in lunch meals of children in some selected preschools in the Cape Coast Metropolis are that:

1. The meals of the children were generally cereal based. Fresh fruits and snacks which could have increased the macro nutrients and mineral element contents of the meals were not served as part of their meals.

2. The nutrient contents of meals served did not meet the 50% of the RDI for lunch; this can partly be attributed to the supposedly inadequate funding which did not make it possible to include meat, liver and fish in the lunch meals for the children.

13. Recommendations

Based on the results obtained, it is recommended that;

1. Protein sources like meat and fish whose cost per unit weight is high could be supplemented with legumes and pulses that are relatively cheaper in order to increase quantity of protein served to the children.

2. Fresh fruit should be served as part of their meals to make their intake balanced.

3. Government should extend the school feeding programme to the preschool level to reduce cost and also relieve parents of solely funding their children's meals.

4. Schools should also employ trained and competent personnel who are equipped with knowledge in nutrition and skills in the preparation of school meals

5. Regular in-service training should be organized by heads of preschools for their cooks to improve their nutritional knowledge on the feeding of the children.

6. Food based recommendations must be developed, promoted and supported through policy initiatives, state licensing and / or national accreditation standards and resources and training for child-care centre staff and parents.

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