PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2020.329.336

Research Article
Nutritional Assessment of Meals Provided to Some Pre-School Children In Central Region, Ghana

[1]Sophia Ohene-Darko and [2]Victor Y. A. Barku

[1]Department of Vocational and Technical Education, College of Education Studies, University of Cape Coast, Cape Coast, Ghana
[2]Department of Chemistry, School of Physical Sciences, College of Agriculture and Natural Sciences, University of Cape Coast, Cape Coast, Ghana

Abstract

Background and Objective: The provision of healthy meals and good nutrition is considered a high priority on every school agenda because of its positive effect on child well-being. Evidence suggests that healthy meals and good nutrition improve learning ability, leading to better academic performance. Many countries including Ghana who prioritised quality nutrition for school children launched various school feeding programmes to provide at least one square meal to children at the lower school levels. In Ghana, some private basic schools adopted the school feeding programme to increase enrolment. This study attempted to assess the nutritional quality of meals provided to children in some of these private basic schools in Cape Coast, Ghana. **Materials and Methods:** Seven schools were randomly selected from which rations of meals served were collected. Both micro and macronutrients were determined and compared with recommended values to assess the nutritional quality of the lunch meals provided to the children in these schools. **Results:** The results obtained showed that almost all food providers in these schools served meals that contain varying amounts of all the necessary micro and macro-nutrients. In addition, the meals contained the recommended levels of the important macronutrients: protein and carbohydrate with fat content was slightly lower than the recommended values. However, all the meals provided to the children in all the selected schools did not contain adequate amount of micronutrients. All the micronutrients analysed did not meet the recommended values. **Conclusion:** Children in these schools are likely to suffer from some deficiency diseases if they continue to depend on the meal served in the schools as their major meal in the day. Providers must be educated on nutrition guidelines while routine check and control measures are required in place to monitor the services rendered by these food providers.

Key words: School feeding, micronutrient, macronutrient, deficiency disease, healthy meals, learning ability

Citation: Sophia Ohene-Darko and Victor Y. A. Barku, 2020. Nutritional assessment of meals provided to some pre-school children in central region, Ghana. Pak. J. Nutr., 19: 329-336.

Correspondi ng Author: Victor Y. A. Barku, Department of Chemistry, School of Physical Sciences, College of Agriculture and Natural Sciences, University of Cape Coast, Cape Coast, Ghana

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

School-age is a period of rapid growth in human development that requires an increase in nutritional demand and establishment of dietary habit. Nutrition of school-age children has direct and short-term influence on physical and mental growth as well as the indirect and long-term influence on the continuing growth and health of a child[1]. This means that malnutrition in any school-age child surely imprints a negative effect on the learning ability, physical and mental developments of that child.

A proper diet improves health, growth and intellectual development of children[2]. Another report states that malnutrition, unbalanced diet and skipping breakfast causes poor dietary habits and could potentially lower children's behavioural development, ability for coping with stimuli, memory and learning ability[1,3]. Dietary habits of children do not only affect health in childhood but also greatly influence dietary habits and health in adulthood. Diets of high nutritional quality are essential in childhood and adolescence periods to meet the physiological and energy needs. This calls for the need to promote healthy dietary habits among children to maintain their nutritional requirements.

The school offers the most favourable environment for the promotion of such a healthy strategy. This is because the school is an assembly point of large number of children of diverse ethnic and socio-economic groups and offers an environment that is accessible to all on equal terms[4].

The school provides an adequate and balanced diet to many children from different walks of life to prevent malnutrition and other associated diseases. Therefore, the provision of healthy food and nutrition should be a high priority on every school agenda because of its positive effect on child well-being. Evidence suggests that healthy food and improved nutrition improve learning ability and leading to better academic performance. The Food Commission, 2001 established a positive link between well-nourished children and improved learning, attendance, behaviour and consequently child-teacher relationships[5].

Since 2005, the government of Ghana has started a school feeding programme to provide one square meal to school going children. This Programme was part of a policy that seeks to achieve three main objectives: (1) Reduce short term hunger and malnutrition in school children, (2) Increase school enrolment, attendance and retention (3) Boost domestic food production[6]. This policy is commended because it provides not only healthy nutritional meals but also increase enrolment, attendance and retention in public primary schools of Ghana[7]

Management of Private schools has also decided to implement similar school feeding programme to enhance their business. Consequently, many private schools in Ghana now provide at least one meal to keep the children in schools. Notwithstanding the advantages of this programme, it may be adversely detrimental to the child's health and development if not properly monitored to ensure the provision of a nutritious meal. This study, therefore, was conducted to assess the nutritional dynamics of meals fed to the Ghanaian children in some pre-schools in the Central Region of Ghana.

MATERIALS AND METHODS

All the necessary reagents and solvents were of analytical grade and obtained from the Department of Chemistry Central store, University of Cape Coast. All the mineral analyses and the proximate compositions were carried out at the Technology Village laboratory, School of Agriculture, University of Cape Coast.

Data collection procedure: In order to collect data, permission was obtained from the heads and proprietors of the 7 randomly selected private pre-schools in Cape Coast Metropolis. Data was collected personally by the researchers involved. In each school, the researcher explained the purpose of the study to heads and cooks and assured them of anonymity and confidentiality of their participation in the study. The heads and cooks had the opportunity to ask questions to clarify all doubts about the study. Three different Portions of the lunch meals were collected from each school every day within a period of 1 week. The dishes collected were kept in clean labelled food containers, allowed to cool and covered with tight-fitting lids to prevent spilling. The food was carefully transported to the laboratory on a daily basis. Weights of both main dishes and accompaniments were recorded. Based on the consistency of the dishes, food samples were dried and blended in a laboratory mortar and pestle before the actual chemical analysis.

Proximate composition of the food samples: The crude protein content was determined by the Kjeldahl method to obtain the crude content. Fat content was obtained by extracting the food samples with petroleum-ether using Soxhlet apparatus. Moisture and ash contents were determined according to the methods described by the Association of Official Analytical Chemists[8].

Mineral analyses: Total Calcium, Magnesium, Phosphorus, Sodium, Potassium, Iron, Copper and Zinc contents of each food sample were determined in this study. The Iron, Copper

and Zinc contents were determined using Atomic Absorption Spectrophotometer (AAS), whilst the Potassium and Sodium levels were determined using Flame Photometer. Calcium and Magnesium were determined by titration methods. The procedures outlined by the AOAC[8] were followed in the analyses and all analyses were conducted in triplicate.

Statistical analysis: Data were expressed as Mean ± standard deviation (n = 15). Data were analyzed using one-way analysis of variance (ANOVA), followed by Tukey Pairwise Comparisons method at 95% Confidence level using Minitab 2000 Version 17.0 statistical software (Minitab Inc., USA). Differences of $p<0.05$ were considered statistically significant.

RESULTS AND DISCUSSION

The school menu: The schools had a cyclical menu which was designed and used throughout the academic year. Similarly, the individual cooks employed by each school were maintained throughout the study period. The meals were provided as lunch in all the schools at 12:30 pm. The children in all these schools averagely were of 4 years old. The portion of food dished out averagely weighed 2.5 kg.

Table 1 shows an overview of the weekly meals consumed in the 7 sampled schools in the Cape Coast Metropolis. The number of meals served in all the schools totalled 35. The main dish consisted of the rice (24 out of 35 meals), beans and gari (3 out of 35 meals), banku (5 out of the 35 meals), kenkey (1 out of 35 meals) and spaghetti (once alone and once combined with rice). The carbohydrate parts of the meals were accompanied with fish, chicken, sausages or eggs and tomato sauce or soup. Fruit was served as a dessert by only one school. No dissert nor fruits were served in addition to the meals in the other six schools. All stews, except for the groundnut soup, were made with oil (vegetable oil or palm oil), onion and tomatoes (fresh and/or tinned).

A previous study indicated that proper diet in childhood is essential for better health, growth and intellectual development[2]. It is also undoubtedly believed that the key to good nutrition is a varied diet that includes every kind of nutrient. The menu provided to each school showed that the children in all these schools were served with varied diets which signified the provision of good nutrition.

Mineral composition: The supply of diet of appropriate dietary macro and micronutrients for adequate growth and development remains very important. No doubt, some countries put human life and socio-economic development at a risk by not paying special attention to the nutritional needs

Table 1: Menu for the various schools

		Days of the week				
Name of school	No	Monday	Tuesday	Wednesday	Thursday	Friday
Good Samaritan sch (S1)	128	Jollof and sausage	P rice and chicken stew	Beans and fried plantain	Plain rice and fried fish stew	Rice ball and groundnut
Cherish Int. sch (S2)	116	Jollof and fried fish	Waakye and fish	Banku/fish and tomato sauce	Banku and okra stew	Beans and fried plantain
Morning star acad. (S3)	50	Rice and palava sauce	Waakye and egg	Fried rice and chicken	Jollof and fish	Rice and fish stew
Calvary crèche and prep (S4)	62	Rice fried gizzard	Plain rice and egg stew	Jollof rice and chicken	Jollof and fish	Banku, gravy % fish
St. Andrew prep (S5)	80	Rice and egg stew	Waakye and fish	Kenkey and fish	Banku and okra stew	Jollof rice and sausage
Destiny child sch (S6)	40	Rice and G' soup	Waakye and egg	Rice and G' soup	Jollof and fish	Banku and okra stew
UCC kg (S7)	216	Jollof and fish	Beans and fried plantain	Waakye and fish	Jollof and fish	Spaghetti and vegetables stew

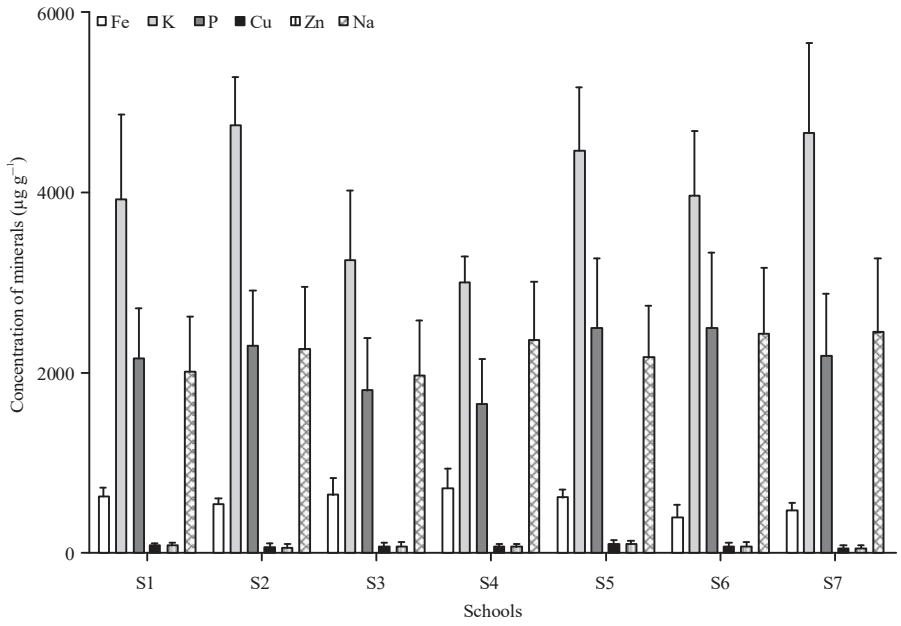

Fig. 1: Bar chart showing the average mineral composition and standard error of the various diets in the schools

Table 2: Levels of average micronutrients determined in the diets provided to the children in the various schools

School	Fe (µg g^{-1})	K (µg g^{-1})	P (µg g^{-1})	Cu (µg g^{-1})	Zn (µg g^{-1})	Na (µg g^{-1})	Ca (%)	Mg (%)
S1	625.8±196.1^{ab}	3959.1±1906^{ab}	2528.0±437.0^{ab}	80.4±37.6^{ab}	52.0±34.9^{a}	2479.0±731.0^{a}	0.89±0.1^{b}	0.11±0.0^{a}
S2	549.7±124.5^{ab}	4783.7±1072^{a}	2759.0±485.0^{ab}	73.9±33.2^{ab}	69.4±63.5^{a}	2990.0±866.0^{a}	0.99±0.1^{ab}	0.19±0.2^{a}
S3	665.2±335.3^{ab}	3274.5±1582^{ab}	2343.0±744.0^{ab}	76.0±46.1^{ab}	52.2±49.4^{a}	2227.0±893.0^{a}	0.92±0.1^{b}	0.16±0.0^{a}
S4	725.0±431^{a}	3008.1±650^{b}	2058.0±558.0^{b}	78.3±21.6^{ab}	50.6±25.8^{a}	2688.0±798.0^{a}	1.01±0.2^{ab}	0.13±0.0^{a}
S5	628.7±87.31^{ab}	4510.7±1420^{ab}	2905.0±679.0^{ab}	111.8±50.^{9a}	60.3±27.0^{a}	2884.0±540.0^{a}	0.09±0.0^{a}	0.13±0.0^{a}
S6	413.3±181.0^{b}	4005.1±1476^{ab}	2949.0±1279.0^{a}	77.3±44.7^{ab}	41.2±23.2^{a}	2718.0±1074.0^{a}	0.94±0.1^{b}	0.11±0.0^{a}
S7	483.6±135.4^{ab}	4683.2±2109^{ab}	2533.0±944.0^{ab}	59.4±44.5^{b}	82.9±73.8^{a}	2878.0±1221.0^{a}	0.95±0.0^{b}	0.14±0.0^{a}

Vertically, means that do not share a letter are significantly different using Tukey Pairwise Comparisons at 95% levels

of school -age children. In developing countries such as India and Ghana, children, adolescents, women of reproductive age and pregnant women continue to suffer from public health problems due to deficiencies in iron, iodine, zinc and vitamin A[9,10]. Inadequate food intake results in an inadequate supply of micronutrients leading to multiple micronutrient deficiencies[11].

Table 2 and Fig. 1 shows the average micronutrients composition of the meals served in the various schools during the study period. The results indicated that all food suppliers tried to provide meals that contain all the essential ingredients to make the meal a balanced diet except vitamins that were not determined hence could not be accounted for. The study also showed the significant differences in the dietary quality between the schools. This showed lack of adherence to dietary guidelines by some food providers. It may also be due to the use of inferior or non-nutritious foodstuffs for preparation of the meals.

Anaemia is the most common nutritional disorders in developing countries. About 50% of anaemia cases are due to iron deficiency[12]. In children, iron deficiency anaemia is associated with decreased physical development, impaired immune function, poor growth and decreased physical activity which also affects cognitive function and school achievement. Poor dietary intake is a contributor to iron deficiency. A diet rich in iron content may reduce iron deficiency. The daily iron supplementation suggested for Preschool-age children (24-59 months) is 30 mg of elemental iron[13]. This study recorded 725.0±431 µg (0.7250 mg) as the highest average daily intake of iron among the 7 schools. This level of iron is significantly far lower than the recommended daily intake. This shows that none of the food providers for each school supplied the right portion of iron. Children of these schools are likely to suffer from iron deficiency diseases if they continue to depend on the provided lunch in their respective schools as the main meal for the day. Similar trend was observed for Zinc. All the schools recorded very low amount of zinc in the served meals. The values were far lower than the recommended dietary intake (4-12 mg) for children between ages 4-8 years[14]. This is a worrying situation that needs attention to avoid Zinc

deficiency in the children to prevent them suffering from impaired growth, as well as poor immune and cognitive functioning.

Sodium is an essential nutrient needed in low quantity for active transport of molecules across cell membranes. However, high sodium intake can increase blood pressure, which is a major risk factor for cardiovascular disease[15,16]. Recommended dietary intake and upper level of sodium is 300-600 mg and 1400 mg respectively for children between ages 4-8 years. The highest amount determined in this study is 2.99 mg which is far lower than the recommended value. Though cardiovascular diseases are associated with higher intake of sodium, whereas lower intake negatively affected the proper functioning of the body.

Increasing calcium intake through food fortification and nutraceutical supplements remains the primary advice to maintain skeletal and bone health[17]. Calcium is particularly important for children and young people to support the rapid growth of bones. Recommended dietary intake and upper level of intake for calcium are 700 and 2500 mg respectively for children between the ages 4-8 years[14]. Also, the daily calcium intake recommended for children between ages 4-6 years is 450 mg[18].These recommended values are far greater than the estimated amount of calcium (Table 1 and Fig. 2). Food providers are advised to increase the use of milk and some milk products (eg, yoghurt and cheese) which are the predominant sources of calcium in the foods they prepare. Copper, Potassium, Phosphorus and Magnesium are other essential trace minerals necessary for survival. Copper is found in all body tissues and plays a role in making red blood cells and maintaining nerve cells and the immune system. It also helps the body form collagen and absorbs iron and plays a role in energy production. The recommended daily allowance (RDA) is around 440 micrograms (µg) a day for children between 4-8 years[19]. Meals from the various schools showed the lower value of copper than the recommended value. This could hinder the formation of red blood cells and slow down the rate of iron absorption.

Increasing intake of potassium is good for the reduction of blood pressure and risk of cardiovascular disease, stroke and coronary heart disease in adults. WHO suggested a potassium intake of at least 3510 mg day^{-1} for adults which can be adjusted downward for children, based on their energy requirements relative to adults[20].

Phosphorus keeps the bones strong and healthy. Phosphorus also helps remove waste and repair damaged tissues. In addition, it contributes to bodily functions that involve the nervous system, kidney function, muscle contraction and heartbeat regulation. The recommended daily allowance for children (4-8 years) is 500 mg[21].

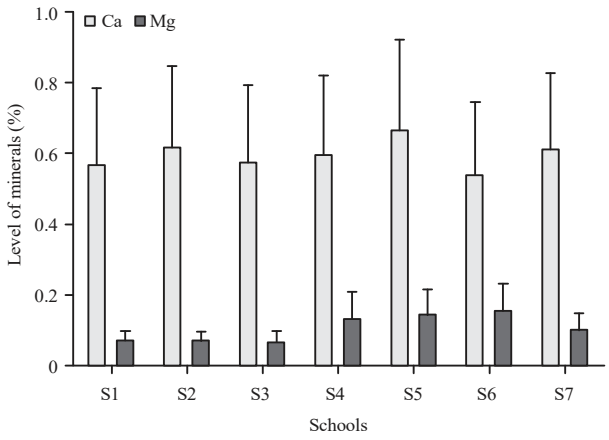

Fig. 2: Bar chart showing the average percentage of Calcium and Magnesium composition and standard error of the various diets in the schools

Magnesium is the most abundant divalent cation within the cells of the body. It is a critical co-factor in more than 300 enzymatic reactions in the human body[22]. The recommended daily allowance of magnesium for children (4-10 years of age) is 110 mg and for adolescents and adults is 350 mg[23].

Unfortunately, values of these essential minerals were found lower than the recommended daily allowances in all the meals served. It is therefore advised that the food providers should utilize food ingredients that are rich in these minerals. Enough time and resources must be spent to select staple crop varieties with high levels of micronutrients.

Proximate analysis: Table 3 and Fig. 3 show proximate composition of diets supplied to the children in various schools. Dietary fibre is the soluble or insoluble parts of plant food that the body can't digest. Dietary fibre relatively remains intact as it passes through the stomach, small intestine and colon and out of the body. A high-fibre diet increases the weight and size of stool and softens it to make it easier to pass thereby decreasing the chance of constipation. The daily fibre recommendations for adults aged 50 years or younger is 38 g for men and 25 g for women. Our results showed that the meals served in all the schools contained little amount of fibre which are significantly lower than the recommended value. Diets that have high fibre contents are beneficial but some micronutrients deficiency (such as calcium, phosphorus, iron, copper and zinc) may occur in children who consume too much fibre[24]. This is because some chemical substances that are associated with fibre can bind certain micronutrients and prevent their efficient absorption.

Children and adults need fat in their diets to supply essential fatty acids (EFA) that aid in the absorption of

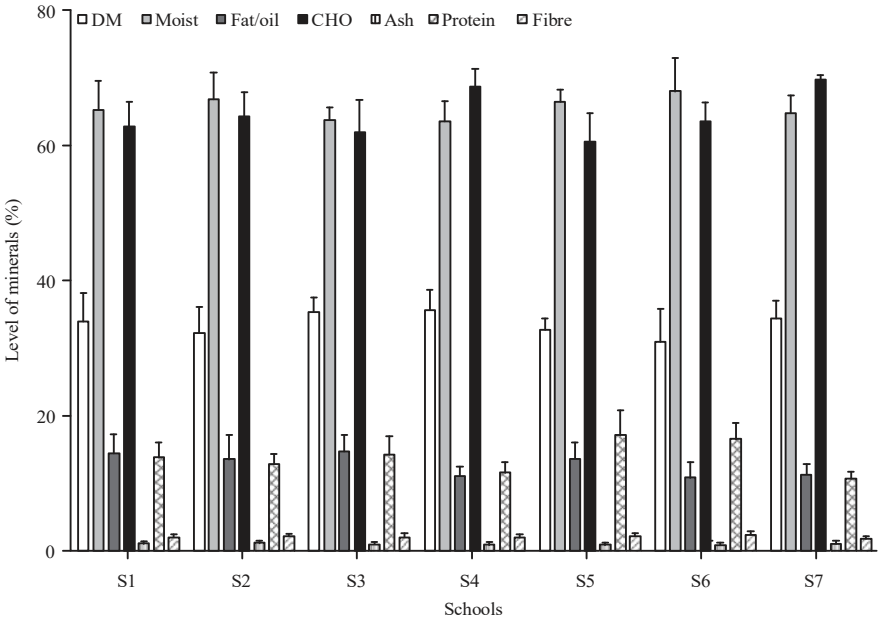

Fig. 3: Bar chart showing the average macronutrient composition and standard error of the various diets in the schools
DM: Dry Matter, CHO: Carbohydrate, Moist: Moisture

Table 3: Proximate composition of diets provided to the children in the various schools

School	DM (%)	Moist (%)	Fat/oil (%)	CHO (%)	Ash (%)	Protein (%)	Fibre (%)
S1	34.25±8.9^{a}	65.75±8.9^{a}	14.69±5.0^{a}	63.34±7.1^{abc}	1.26±0.3^{ab}	14.04±4.0^{ab}	2.12±0.6^{a}
S2	32.55±7.9^{a}	67.45±7.9^{a}	13.69±7.1^{a}	64.96±6.9^{abc}	1.37±0.3^{a}	13.01±3.0^{ab}	2.29±0.7^{a}
S3	35.70±3.8^{a}	64.30±3.8^{a}	14.95±4.6^{a}	62.56±9.5^{bc}	1.20±0.1^{abc}	14.47±5.2^{ab}	2.22±0.7^{a}
S4	35.93±6.0^{a}	64.07±6.0^{a}	11.23±2.5^{a}	69.17±5.6^{ab}	1.07±0.1^{bc}	11.74±2.9^{b}	2.07±0.6^{a}
S5	32.94±3.5^{a}	67.06±3.5^{a}	13.92±4.6^{a}	60.96±8.6^{c}	1.03±0.1^{bc}	17.31±6.9^{a}	2.27±0.6^{a}
S6	31.31±9.7^{a}	68.69±9.7^{a}	11.03±4.4^{a}	64.05±5.7^{abc}	0.97±0.2^{c}	16.70±4.6^{b}	2.50±0.8^{a}
S7	34.68±5.4^{a}	65.32±5.4^{a}	11.37±3.1^{a}	70.39±1.1^{a}	1.22±0.3^{ab}	10.92±1.7^{b}	1.89±0.6^{a}

Vertically, means that do not share a letter are significantly different using Tukey Pairwise Comparisons at 95% levels. DM: Dry Matter, CHO: Carbohydrate, Moist: Moisture

fat-soluble vitamins A, D, E and K. It is a substrate for the production of hormones and mediators[25]. Fat is also essential for neurological development and brain function especially in infancy and early childhood depending on the amount and quality of dietary fat consumed. Adequate amounts of dietary fats are essential for good health as well as to meet energy needs. Sufficient intake of dietary fat helps to meet requirements for essential fatty acids and fat-soluble vitamins. However, excessive dietary fat intake has been linked to increased risk of obesity, coronary heart disease and certain types of cancer. A significant amount of fat was observed in diets provided to all schools. However, the percentage compositions are lower than AMDR recommendation for fat (15-25%)[26] or (20-35%)[27]. For instance, School 3 recorded 14.95±4.6% fat contents which is the highest while school 6 recorded 11.03±4.4% fat contents to constitute the lowest value determined. According to National Children's Nutrition Survey[14], the Mean daily total fat intake (as a percentage of total energy intake) for children between 5-6 years is 32 for male and 31 for female. The low amount of total fat contents observed in the diets may be due to small amount of saturated fat. This is likely to reduce the impact of Low-density lipoprotein (LDL)which is a factor responsible for increased risk of cardiovascular disease. Meanwhile, the food providers can be educated on dietary fat intake so that they can always provide diets that are low in total saturated and trans fat and high in monounsaturated and polyunsaturated fats. Porper dietary fat intake in children and young people can reduce the risk of developing cardiovascular disease in later life.

Protein, carbohydrate and fat are the three main classes of food that provide energy to the body. These macronutrients are therefore required to be present in their right proportions in every meal served. According to the data obtained from the fifth Korean National Health and Nutrition Examination Survey, the AMDR for carbohydrate is 55-70%, for fat is 15-25% and for protein is 7-20% of the energy intake[26]. Our analysis

showed that the meals served in all the schools contained averagely the required amount of protein and carbohydrate. We recorded 17.31±6.9% as the highest and 10.92±1.7% as the lowest protein content while 70.39±1.1% as the highest and 60.96±8.6% as the lowest carbohydrate content. These results indicate that the children consumed the essential dietary nutrients at sufficient levels and possess adequate energy for physical activity, thus have reduced risk of chronic disease.

In a food product, moisture content is considered the most critical factor for microbial growth which can make food unfit for human consumption, leading to illness or death. The measured moisture content in this study ranged from 64.30±3.8% to 68.69±9.7%. These are higher than 10%, a value needed to avoid microbial growth[28]. This could make the meals unpleasant if stored for a longer period.

Ash contents of fresh foods rarely exceed 5%, although some processed foods can have ash contents as high as 12%[29]. All the food samples recorded values far lower than 5% which showed the low level of ash contents in the micronutrient composition.

CONCLUSION

The study showed that the dietary quality of the lunch provided to children in the sampled schools was low in terms of minerals and that the necessary ingredients were not adequately provided and if continued could negatively affect the child's growth and academic performance. However, the important energy-providing nutrients, protein and carbohydrates were provided in substantial amount except fat whose provision was slightly lower than recommended. It is possible to improve the micronutrient density of the food by increasing fruits and vegetables consumption. Fortification or mineral supplementation helps to reduce micronutrient deficiencies in many developed countries. More emphasis therefore should be placed on fortifying foods with micronutrients such as calcium, iron, vitamin A and zinc through national fortification programs.

REFERENCE

1. Choi, E.S., N.R. Shin, E.I. Jung, H.R. Park, H.M. Lee and K.H. Song, 2008. A study on nutrition knowledge and dietary behavior of elementary school children in Seoul. Nutr. Res. Pract., 2: 308-316.
2. Kim, S.H., W.K. Kim and M.H. Kang, 2016. Relationships between milk consumption and academic performance, learning motivation and strategy and personality in Korean adolescents. Nutr. Res. Pract., 10: 198-205.
3. Seung, S.J., S. Mi-Kyung, C. Mi-Kyung, K. Young-Rim and K. Soon-Ja *et al*., 2001. An ecological study of food and nutrition in elementary school children in Korea. Korean J. Community Nutr., 6: 150-161.
4. Sabinsky, M.S., U. Toft, H.M. Sommer and I. Tetens, 2019. Effect of implementing school meals compared with packed lunches on quality of dietary intake among children aged 7–13 years. J. Nutr. Sci., Vol. 8 10.1017/jns.2018.29
5. WHO, 2006. Food and Nutrition Policy for Schools: A Tool for the Development of School Nutrition Programmes in the WHO European Region. Programme for Nutrition and Food Security WHO Regional Office for Europe.
6. Mwendwa, E. and J. Gori, 2019. Relationship between school feeding programme and the pupils' effectiveness in learning in public primary schools in Kitui county. Sci. Res. J., 10.31364/SCIRJ/v7.i7.2019.P0719667
7. Eric, O.O. and A.Y. Gyapong, 2014. The contribution of the Ghana schools feeding programme to basic school participation: a study of selected schools in the Kwaebibirim District of Ghana. Developing Country Stud., Vol. 4 https://iiste.org/Journals/index.php/DCS/article/view/16050
8. AOAC., 2000. Official Method of Analysis. 17th Edn., Association of Official Analytical Chemists Inc., Maryland, USA., ISBN-13: 9780935584240..
9. Bamji, M.S. and K.M. Nair, 2016. Food-based approach to combat micronutrient deficiencies. Proc. Indian Nat. Sci. Acad., 82: 1529-1540.
10. National Nutrition Policy for Ghana 2013-2017, 2013. Ministry of health and Ghana health Service. https://extranet.who.int/nutrition/gina/sites/default/files/GHA%202013%20National%20Nutrition%20Policy.pdf
11. Beal, T., E. Massiot, J.E. Arsenault, M.R. Smith and R.J. Hijmans, 2017. Global trends in dietary micronutrient supplies and estimated prevalence of inadequate intakes. PLoS One, Vol. 12. 10.1371/journal.pone.0175554
12. Tarkang, E., E. Manu, H. Amu, M.A. Ayanore and F.Y. Aku *et al*., 2019. Risk factors of anaemia among children under five years in the hohoe municipality, Ghana: a case control study. Anemia, Vol. 2019 10.1155/2019/2139717
13. WHO., 2016. Guideline: Daily Iron Supplementation in Infants and Children. World Health Organization, Geneva, .
14. Ministry of Health, 2012. Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2–18 years): A background paper, Wellington: Ministry of Health. https://www.health.govt.nz/publication/food-and-nutrition-guidelines-healthy-children-and-young-people-aged-2-18-years-background-paper
15. Sacks, F.M., L.P. Svetkey, W.M. Vollmer, L.J. Appel and G.A. Bray *et al*., 2001. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. N. Engl. J. Med., 344: 3-10.

16. He, F.J. and G.A. MacGregor, 2004. Effect of longer term modest salt reduction on blood pressure. Cochrane Database Syst. Rev., 10.1002/14651858.CD004937
17. Framroze, B. and F. Havaldar, 2018. An *In vitro* study on the effect of five commercial calcium supplements on human osteoblast cell proliferation and Ca^{2+} mineralization. J. Nut. Food Sci., 10.4172/2155-9600.1000738
18. British Dietetic Association (BDA), 2017. Food Fact Sheets. https://www.bda.uk.com/food-health/food-facts.html
19. Food and Nutrition Board, 2001. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc. National Academy Press, Washington, DC., ISBN-13: 9780309072908, Pages: 800.
20. WHO., 2012. Guideline: Potassium Intake for Adults and Children. Geneva, 27, Switzerland. https://www.who.int/publications/i/item/9789241504829
21. Institute of Medicine (IOM), 1997. Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D and Fluoride. 1st Edn., National Academy Press, Washington, USA,.
22. Schachter, M.B., 2019. The Importance of Magnesium to Human Nutrition. Schachter Center for Complementary Medicine. http://www.mbschachter.com/importance_of_magnesium_to_human.htm
23. Olivares, M. and R. Uauy, 2005. Essential Nutrients in Drinking Water. In: Nutrients in Drinking Water. World Health Organization Geneva pp: 41-60.
24. Adams, S., Sello, C.T., G.X. Qin, D. Che and R. Han, 2018. Does dietary fiber affect the levels of nutritional components after feed formulation? Fibers, Vol. 6 10.3390/fib6020029
25. Milner, J.A. and R.G. Allison, 1999. The role of dietary fat in child nutrition and development: Summary of an ASNS workshop. J. Nutr., 129: 2094-2105.
26. Lee, E., J. Choi, A. Ahn, E. Oh, H. Kweo and D. Cho, 2015. Acceptable macronutrient distribution ranges and hypertension. Clin. Exp. Hypertens., 37: 463-467.
27. Harcombe, Z., 2018. US dietary guidelines: is saturated fat a nutrient of concern? Br. J. Sports Med., 53: 1393-1396.
28. Zambrano, M.V., B. Dutta, D.G. Mercer, H.L. MacLean and M.F. Touchie, 2019. Assessment of moisture content measurement methods of dried food products in small-scale operations in developing countries: A review. Trends Food Sci. Technol., 88: 484-496.
29. Ismail, B.P., 2017. Ash Content Determination. In: Food Analysis Laboratory Manual. Nielsen, S.S., Springer, Cham Switzerland pp: 117-119.