

Nutrition Status of Children in Orphanages in Selected Primary Schools within Dagoretti Division Nairobi, Kenya

Elizabeth W Mwaniki* and Makokha AN

Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya

Abstract

Background: School-age children are particularly vulnerable to under nutrition as the priority in nutrition interventions is often to prevent malnutrition during fetal development and the first years of life. Children stunted at school age are likely to have been malnourished since early childhood. However children can exhibit catch up growth if their environment improves thus interventions for school age children can supplement efforts in the preschool years to reduce levels of stunting.

Objective: Assess the nutrition status and associated risk factors of primary school children living in orphanages in selected primary schools in Dagoretti Division, Nairobi.

Design: Cross-sectional survey

Setting: Peri-urban Primary school children from three orphanages

Subjects: Two hundred and eight, four to eleven year olds from three randomly selected orphanages.

Results: Among the children surveyed, 47.2%, 33.2 and 9.2% were stunted, underweight and wasted, respectively. There were more boys stunted and wasted than girls. Stunting increased from 4.8% to 24.5% and underweight from 2.9% to 16.4% in children who had stayed in the orphanage for 12 months and 36 months respectively. The children consumed only 11.2% of the daily energy intake from breakfast. Only 50% of the children took the three main meals of the day. Morbidity rates were higher among boys than girls. Only 12.8% of the children washed hands with soap after visiting the toilet.

Conclusion: The few meals taken meant that the children were hungry most of the morning and those who did not take lunch were hungry most of the day. High morbidity rate, inadequate amounts and diversity of foods served to the orphanage children and low basic hygiene are important malnutrition predictors. The rate of chronic under nutrition became more apparent with long duration of stay in the orphanage. Efforts should be directed towards increasing energy intake in the orphanages' diets.

Keywords: Energy; Hygiene; Malnutrition; Stunting; Underweight; Wasting; Orphanage; Morbidity

Introduction

The number of orphans due to all causes is likely to reach a staggering 50 million by 2015 in Africa [1-4]. HIV/ AIDS, conflict, natural disasters, endemic diseases such as malaria and tuberculosis, and rising poverty has claimed the health and lives of millions of productive adults in Africa, leaving their children orphaned and vulnerable [5]. In sub-Saharan Africa the number of orphans and vulnerable children is predicted to comprise up to 8.9% of the global orphan children under the age of 15 years [5]. It is estimated that by 2015 the number of orphans and vulnerable children will still be overwhelmingly high in Sub Saharan Africa. Currently there are over 2.4 million orphans and vulnerable children, 47% of these were as a result of HIV/AIDS [6]. The ever-increasing number of orphans and vulnerable children in Kenya will inevitably have a profound impact on societies in which they live. In Kenya it is the high number of orphans and vulnerable children that is potentially the biggest long-term crisis, yet few studies have seriously delved into their plight. The impact of HIV/AIDS compounded with high level of poverty has subjected these children to deplorable conditions denying them adequate access to basic needs of life necessary for their proper growth and development. These large numbers of orphan and vulnerable children have resulted in mushrooming of orphanages. Among these Orphans and Vulnerable Children, young children below the age of eight represent an extremely vulnerable population [7]. Recent research has shown that as many as

200 million children worldwide fail to reach their cognitive and socio-emotional potential because of malnutrition, micronutrient deficiency, and lack of stimulation during early childhood [8]. These findings are especially pertinent for Africa, where 15 percent of all orphans, or about 6.5 million children, are under 5 years of age [9].

School-age children are particularly vulnerable to under nutrition as the priority in nutrition interventions is often to prevent malnutrition during fetal development and the first years of life – the most critical period for growth and development [1]. The most documented forms of malnutrition in Kenya are protein energy malnutrition and vitamin A deficiencies among under-fives [10,11]. Malnutrition in orphanage children is completely lacking in National surveys. In Malawi, 64 % of orphanage children were stunted compared with 46 % of the non-orphanage children [12]. In Zimbabwe a strong association was found

*Corresponding author: Prof. Elizabeth W Mwaniki, Jomo Kenyatta University of Agriculture and Technology, Nairobi, P.O Box 184-00200, Kenya, Tel: +254722 237 600; E-mail: lizmwaniki@yahoo.co.uk

Received October 25, 2013; Accepted December 23, 2013; Published December 28, 2013

Citation: Mwaniki EW, Makokha AN (2013) Nutrition Status of Children in Orphanages in Selected Primary Schools within Dagoretti Division Nairobi, Kenya. J Nutr Food Sci 4: 248. doi: [10.4172/2155-9600.1000248](http://dx.doi.org/10.4172/2155-9600.1000248)

Copyright: © 2013 Mwaniki EW, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

between living in an orphanage and nutritional and health outcomes such as diarrhea, acute respiratory infection, and underweight status among 5-10 year old children. In the same study orphanage children were more wasted (9%) compared to non-orphanage group (2%) [13]. Children stunted at school age are likely to have been exposed to poor nutrition since early childhood and the degree of stunting can tend to increase throughout the school age years [2]. However children can exhibit catch up growth if their environment improves. This suggests that interventions for school age children can supplement efforts in the preschool years to reduce levels of stunting [3]. Underweight among school age children can reflect prenatal under nutrition, deficiencies of macro- and micro- nutrient, infection and, possibly inadequate attention by care givers [14]. Wasting is not as common as either stunting or underweight in school age children [15]. Based on the literature it is important to determine whether orphanage children attending school in Dagoretti Nairobi, Kenya are potentially malnourished.

Materials and Methods

Social-demographic information

A structured questionnaires was used to collect demographic which included, age, sex and educational level of the caretakers of the orphanage children. Data on period of stay in the orphanage, morbidity occurrence, health seeking behaviour and common types of foods taken was also collected from caretakers of orphanage children.

Study Subjects

This cross sectional study was conducted between November 2009 and February 2010 in children between 4-11 years representing three out of the six government registered orphanages from Peri-urban primary school children in Dagoretti Division, Nairobi Kenya.

Anthropometry

Anthropometric data, which included, height, weight and age was collected from orphanage children. Date of birth was obtained from the orphanages' records. EPI INFO (Version 3.3.2) was used to calculate Height-for-age (HAZ), Weight- for- age (WAZ) and Weight- for-Height (WHZ) Z-scores. Children with HAZ, WAZ and WHZ scores between -2.99 and -2.00 were considered to have moderate stunting, underweight and wasting respectively, while those with -3.00 and below were severely stunted, underweight and wasted respectively [16]. These variables were considered as the dependent variables during statistical analysis.

Statistical analysis

Data were analysed using Statistical Package for Social Sciences, SPSS (Version 14.0). Nutri Survey programme was used to calculate the caloric contribution of each meal to the children's daily caloric intake. Statistical analysis included t-test for proportions, Chi-square and Pearson product moment. Statistical significance was set at $p < 0.05$.

Ethical consideration

The objectives of the study were communicated to the school children and participation was completely voluntary. Study participants provided written consent prior to participation. Informed consent forms were signed by the care-takers and the management of the orphanage children before commencing the study and there was a 100% participation rate. The information obtained from the participants was not divulged and was held in confidence. Permission

was sought from all the relevant authorities: Ministry of Education Science and Technology, the proprietors of the Orphanages and from Kenya Medical Research Institute Ethical and Review Board.

Results

Indicators of malnutrition were assessed against potential independent variables such as variety of foods consumed, energy intake, disease prevalence, vaccination rates, hygiene practices and duration of stay in the orphanage. The sample consisted of children who were equally distributed between age 4 and 11 years. These age categories of children still need care and supervision, particularly in matters of personal hygiene. The children were also distributed equally among boys and girls (Table 1). The study was carried out in four primary schools.

Overall there were thirty three caretakers with one orphanage having eleven, the second ten and the third twelve caretakers. These were employed on full time basis to take care of the children in the orphanages. The majority (51%) of the caretakers had attained post primary education.

The orphanage children who attended school away from the orphanage had two meals (Breakfast and Supper) in a day during school days and three meals (Breakfast, Lunch and Supper) during the weekend. These comprised 50% of all the orphanage children. The cereals food group contributed the highest amount by weight (497.3 g) and proportion (34.2%) to the total diet for the orphanage children. Fruits 0.7% (10.1 g) and spread 0.1% (1.7 g) made a small contribution to the orphanage children's dietary intake. Plantain and Eggs were completely lacking in their diet. A total of 37 food items were consumed by the orphanage children (Table 2). Only 7.2% of orphanage children consumed more than four food groups while majority, 92.9% consumed less than four food groups ($t=20.4$, $df=207$, $p=0.000$).

The total mean energy intake among the orphanage children who took lunch was 1547 Kcl. The mean energy intake of orphanage children who did not take lunch was almost half (868 Kcl) of those who took lunch. Breakfast contributed the lowest mean energy intake for the day (11.2%). Lunch (44%) and supper (45%) contributed similar proportion of mean energy intake.

The total nutrient intake was computed and compared to the recommended daily allowance for each age set and by sex of children [17] these were 1352 and 1698 Kcl for 4-6 and 7-9 year age groups, whereas for the 10-11 year group, they were 2326 Kcl for girls and 2824 Kcl for boys. Overall 37.1% of the children took adequate energy calories (Table 3).

The boys had a higher rate of stunting (26%) and wasting (4.8%) compared to girls (stunting, 21% and wasting, 4.3%). However girls

		Orphanage children(n=208)	
		n	%
Orphanages	Jamry	80	38
	Rafyk	68	33
	Grand	60	29
Age in years	4-7	104	50
	8-11	104	50
Sex	Boys	104	50
	Girls	104	50

Table 1: Distribution of children by age, sex and orphanage.

Food groups	Amount consumed from each food group (g)
	contribution to the total diet(Percentage)
Cereal based grains (Ugali, maize and beans, Rice, Chapattis, bread, porridge)	497.3 (34.2%)
Vegetables (cabbage, Kales, spinach)	227.1(15.6%)
Legume grains (Beans, Green grams, Lentils)	232.1 (16%)
Dairy (Fresh or fermented milk)	147.7 (10.2%)
Eggs	0 (0%)
Meat (chicken, fish, beef)	66 (4.5%)
Fruits	10.1 (0.7%)
Spread (margarine, butter, fruit jam)	1.7 (0.1%)
Sugar	29.7 (2%)
Tea/Cocoa	231.3 (16%)
Plantain	0 (0%)
Tubers and Roots (Irish potatoes, Sweet potatoes, Carrots)	11.0 (0.8%)
Total	1454 (100%)

Table 2: 24 hour recall of the foods consumed by the children.

Age (years)	Sex	Orphanage children
4-6	Boy	31 (14.9%)
	Girl	28 (13.5%)
7-9	Boy	7 (3.4%)
	Girl	11 (5.3%)
10-11	Boy	0
	Girl	0
Total		77 (37.1%)

Table 3: Adequacy of energy intake among the orphanage children.

Nutritional status by sex (Z score \leq -2.00)	Sex	Orphanage children			
		n	%	Total n (%)	Statistics
Stunting	Boys (n=104)	54	26.0	98 (47.2%)	t=1.40, df=205.5, p=0.918
	Girls (n=104)	44	21.2		
Underweight	Boys (n=104)	33	15.9	69 (33.2%)	t=0.442, df= 205.4, p=0.329
	Girls (n=104)	36	17.3		
Wasting	Boys (n=104)	10	4.8	19 (9.2%)	t=0.240, df=205, p=0.595
	Girls (n=104)	9	4.3		

Table 4: Prevalence of malnutrition among orphanage children and by sex.

(36%) had a higher rate of underweight than boys (33%). These differences were not significant at $p < 0.05$ (Table 4).

Prevalence of malnutrition seemed to increase in proportion with increase in length of stay in the orphanage (Figure 1). These differences were significant ($X^2=1$, $df=3$, $p=0.000$) for stunting and underweight but not significant ($X^2=0.79$, $df=3$, $p=0.50$) for wasting.

The children in the three orphanages suffered from various infections whose symptoms included colds/flu, diarrhea, vomiting, fever and skin rashes. The children who had been sick in the previous seven days comprised 33 % of the total number of orphanage children.

Prevalence of morbidity was significantly higher ($t=2.61$, $df=206$, $p=0.005$) among boys (27.9%) than girls (13.5%) ages 4-7 years. Similarly, prevalence of morbidity was also significantly higher ($t=2.56$, $df=206$, $p=0.006$) among boys (18.3%) than girls (6.7%) ages 8-11 years.

Of the orphanage children ages 6-11 years, 48% reported washing hands after visiting the toilet, 49.4% washed hands before meals and 12.8% washed hands with soap during the critical times, the day before the interview.

The factors that showed significant difference were correlated to the malnutrition indices of stunting, underweight and wasting (Table 5). The proportion of stunted, underweight and wasted children was

inversely and significantly ($p < 0.05$) correlated with children's energy intake, variety of foods and washing hands with soap. Diarrhoea and colds/cough and duration of stay in the orphanage were positively and significantly correlated to the prevalence of stunted, underweight and wasted orphanage children.

Discussion

The findings of this study are similar to Western Kenya study where cereals contributed the highest proportion of food energy (45.1%) for school children [18]. However the contribution of the cereal fell far below the recommendation of food based dietary guidelines of 55% [19,20]. This study also concurs with 1999 micronutrient survey, which reported a relatively low consumption of fruits in Kenya [21]. Similarity among the low cereal consumption and its highest contribution to the proportion of the total mean weight of foods consumed was not unexpected, since the community agricultural activities had declined due to urbanization. Therefore to a large extent the orphanages depended on purchased food rather than on own-produced food.

The calories (less than 12% of the daily energy intake) derived from breakfast; equivalent to four slices of bread was too low to enable the children to perform adequately until lunch. This suggests that the children were hungry for a great part of the morning. Supper was a more important source of energy (45%) compared to lunch (44%). The

Variable	Malnutrition		Stunting	Underweight	Wasting
			r	r	r
Age of child			0.23*	0.03	0.07
Education of caretakers			0.07	0.02	0.00
Energy intake	4-7years		-0.37*	-0.40*	-0.29*
	8-11 years	Boys	-0.92***	-0.58**	-0.53**
Girls			-0.49**	-0.45**	-0.36*
Variety of foods			-0.88***	-0.71***	
Vaccination	Girls		-0.49**	-0.64**	-0.34*
	Boys		-0.72***	-0.69**	-0.38*
Morbidity	Diarrhea		0.88***	0.90***	0.53**
	Cough/colds		0.39*	0.50**	0.45**
Duration of stay in the orphanage			0.52**	0.63**	0.29*
Hygiene practice	Bathing		-0.66**	-0.49**	0.00
	Brushing teeth		-0.06	-0.05	0.00
	Washing hands(with soap)		-0.92***	-0.58**	-0.51**

KEY: p<0.05*: p<0.01**: p<0.001***

*p-values were significant at p<0.05, ** p-values were significant at p<0.01 and ***p-values were significant at p<0.001. p-values that are not starred were not significant at p<0.05.

Table 5: Correlation coefficient between various factors and malnutrition among orphanage children.

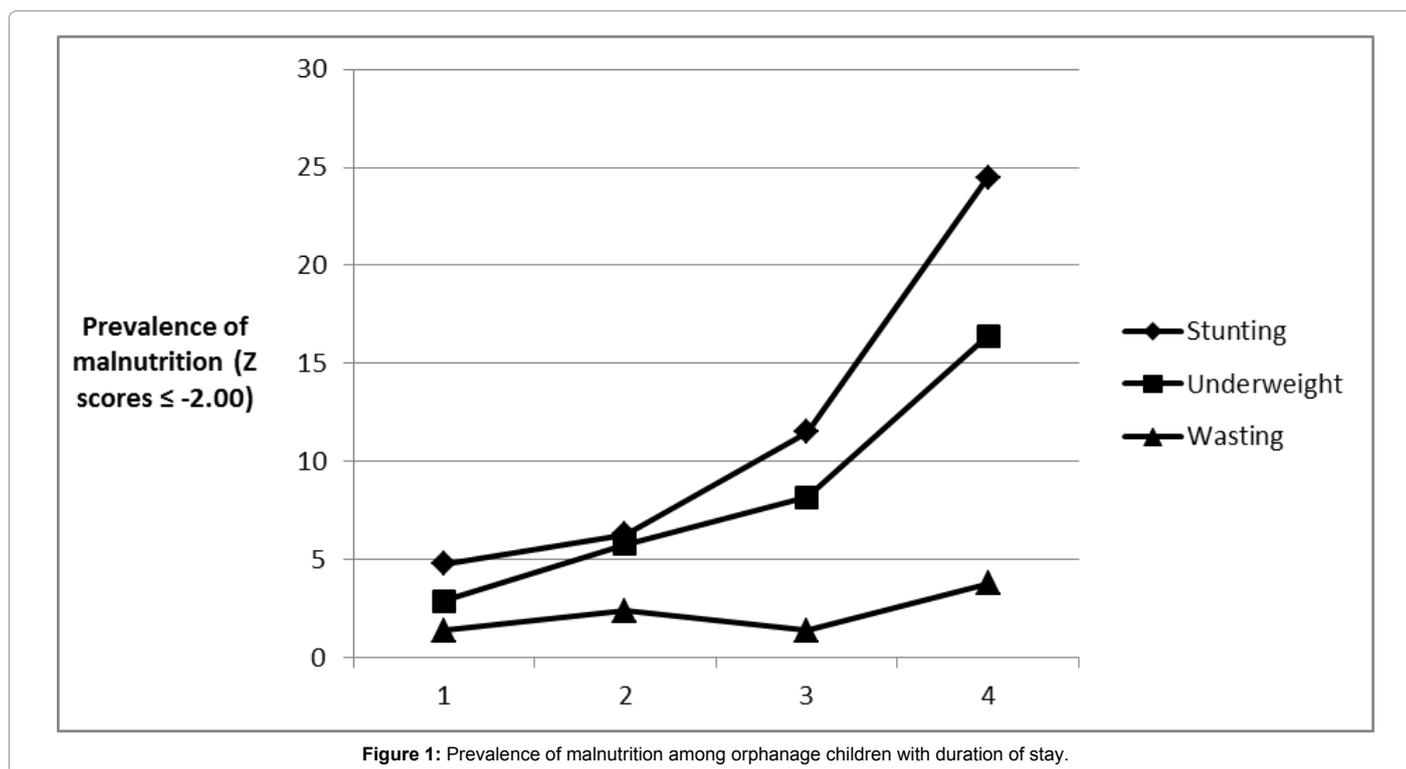


Figure 1: Prevalence of malnutrition among orphanage children with duration of stay.

low energy intake observed in this group is of concern.

Even for the children who took lunch, the overall energy intake did not improve much, as indicated by the study data: with lunch 1547 Kcl, without lunch 869 Kcl. These findings are similar to the Pakistan study which observed that orphanage children had lower intakes of calories for breakfast (less than 10%). Similarly, in this study supper was a more (54.7%) important source of energy compared to lunch (34.6%) for orphanage children [22].

The proportionately high contribution of lunch and supper to

daily energy intake implies that more emphasis was placed on these two meals than on breakfast. However the mean energy intake for individuals for orphanage children didn't meet the energy requirements for all children. Only 37% the orphanage children met their energy requirements. This proportion of children is lower compared to the Western Kenya findings where 63.7% of school children met the recommended daily energy allowance [18].

Foods that provide the body with adequate nutrients to support all the functions are associated with good health [23]. It could therefore be suggested that for those children whose energy intake fell below

the recommended, they were at risk of suffering from nutritional deficiencies. The children who did not meet the energy requirements possibly were given small amount of food. They could also have been the children who only took two out of the possible three main meals of the day.

The orphanage diet consisted of 37 different foods. This diet was dominated by basic staple foods supplemented by complimentary foods usually, in form of stews. Staples such as maize and rice were observed as sources of energy among the orphanage children. It was further observed that there was a tendency towards exclusive reliance on starches and legumes. Food eaten by children in the orphanages mainly depended on donations. Majority 92.9% of the orphanage children were served meals with less than four food groups. Only a small (7.2%) proportion of the orphanage children were served meals with four or more food groups. These results are similar to a Pakistan study which found 6.5% of orphanage children consumed four or more food groups [22].

Conversely, another study in Western Kenya found that all the children in the study consumed four or more food groups [18]. The consumption of a varied diet is associated with increased intake of energy and better health [24]. Children may be served with large servings of starchy cereals because they are bulky thus giving satiety value.

Breakfast, lunch and supper were the main meals of the day. However, it was found out that disparities existed in the frequency of meals per day. The orphanage children who attended school away from the orphanage had two meals (mainly breakfast and supper) in a day during school days and three meals during the weekend. Some orphanage children who were in pre-school in the orphanage had three meals in a day. Approximately 50% of orphanage children took two meals in a day during the week. This was explained by the long distance between the orphanages and the schools they attended (two to three kilometers away from school). No effort was made to pack food or snacks for the midday meal. The number of meals served to a child is important in promoting growth. Foods given in adequate portions and frequently foster better health and growth in children than bulky and rare servings [25]. However the quality and quantity of food given to a child is very important. The average child up to 11 years of age needs to eat every 4-6 hours to maintain a blood glucose level sufficient to adequately support physical and mental activities [26]. This implies that the orphanage children who took two meals in a day were hungry most of the day.

Orphanage children were more likely to be stunted and this was associated with lower levels of, energy intake, variety of foods and washing hands with soap rates. The higher stunting rate among the orphanage children was also associated with longer duration of stay in the orphanage, higher prevalence of diarrhoea and colds/cough and older children.

These findings concur with the study in Zimbabwe where stunting rates of orphanage children were directly correlated to length of stay in the orphanages [27]. Another study in North Western Tanzania found higher stunting levels among orphanage children and this increased with increase in age of the children [28].

The factors that could have contributed to high prevalence of stunting among the orphanage children included limited varieties and diversity of foods served to the orphanage children, the few meals taken in a day, inadequate energy intake, the over dependence on cereals which have low bioavailability and provide poor quality nutrients and

the high prevalence rate of disease among the orphanage children. The high levels of stunting could imply that children received inadequate care from the caregivers (fathers, mothers or childhood caregivers) which include food, healthcare and emotional support necessary for the healthy growth and development of children. The caregivers possibly had in sufficient resources such as time, energy and money.

Children stunted at school age are likely to have been exposed to poor nutrition since early childhood and the degree of stunting can tend to increase through the school age years [2]. However children can exhibit catch up growth if the environment improves [3]. This could imply that the orphanage did not offer a conducive environment that could improve the children's nutritional status thus the longer the length of stay in the orphanage the more likely it was for the child to be stunted.

Underweight rate was also high among the orphanage children and this was also associated with longer duration of stay in the orphanage and higher prevalence of diarrhoea and colds/cough.

These findings are similar to the Zimbabwe study which found a negative correlation between age of children and prevalence of underweight [13]. Another study in Nicaragua found a direct relationship between prevalence of underweight among orphanage school children and diarrheal, coughs/colds and length of stay in the orphanage [29].

Deteriorating standards of living, disease prevalence and increase in food prices could have contributed to the high prevalence of under nutrition. Underweight among school children can reflect prenatal under nutrition, infection and possibly inadequate attention by caregivers [19]. This could imply that children in the orphanage were disadvantaged in terms of care and may have had inadequate intake of energy nutrients in the recent past. The high dependence on cereals and legume grains could have resulted in extremely high phytate and fiber content of these diets thus rendering the energy nutrient bio unavailable [30]. The orphanage children walked to and from school daily and this may have enhanced their physical activity thus increasing their energy requirement [31]. They may also have suffered episodes of disease.

Orphanage children were more likely to be wasted and this was associated with lower levels of energy intake, variety of food and washing hands with soap rates. They were also more likely to be wasted and this was associated with high levels of diarrhoea and cough/colds rates.

Adequate dietary intake is essential for good nutrition. It may, however, not be sufficient, because the presence of disease can result in reduced bioavailability, increased needs, nutrient losses or loss of appetite and can thus be an immediate cause of malnutrition [32]. The high prevalence of wasting in this sample could have resulted from the high prevalence of diarrheal and cough/colds resulting in reduced appetite for food. Possibly, some children suffered from more than one infectious disease thus culminating in this high rate of nutritional wasting. They could also have suffered acute food crisis thus becoming severely malnourished.

Boys had a higher prevalence rate of stunting and wasting than girls. On the other hand girls had a higher rate of underweight than boys. However these rates were not significantly different. The findings were similar to the Machakos study where school girls were at a higher risk of being underweight compared to school boys of the same age [33]. A study in Nyambene District, Kenya also found that the nutritional

status (stunting, underweight and wasting) of girls was better than that of boys, although the difference was not statistically significant [34]. In Brazil school age boys were significantly more stunted than girls of the same age [35].

The higher levels of stunting among boys could have been contributed by high prevalence of disease among boys which could also be associated to the low rates of hand washing at critical times. Inadequate energy intake among the orphanage children could have contributed to the high stunting levels among boys than girls mainly because boys (above 10 years of age) require more food than girls of the same age [17]. It could also be explained by the fact that more girls than boys were involved in food preparation and therefore likely to consume more food than boy's overtime. Further, since stunting increases with age, it is likely that more boys than girls were stunted in their childhood.

The orphanage children who had been admitted to the orphanages for a longer period were more likely to be stunted and underweight ($p < 0.05$) than those who had been recently admitted. These findings differ from those of the study in Malawi where children who had been admitted to an orphanage for more than one year were less malnourished [36] than those who had been admitted for a shorter time. It could also imply that nutritional care in the orphanage is less than optimal, resulting in chronic long term malnutrition.

Acknowledgements

We thank Jomo Kenyatta University of Agriculture and Technology, members of Kenya Medical and Research Institute Scientific Committee and Children's homes for their cooperation and support.

References

1. Bundy D, Schaeffer S, Jukes M, Beegle K, Gillespie A, et al. (2006) School-Based Health and Nutrition Programs. Disease Control Priorities in Developing Countries (2nd Edn), New York: Oxford University Press 1091-1108.
2. Gillespie S, Kadiyata S (2004) Rethinking food aid to fight AIDS. International nutrition foundation for United Nations University. Food and nutrition bulletin Vol. 25 no. 3. United Nations University press. 272-282.
3. World Health Organization (WHO) (2008) Schools and health; their nutrition and health in Kenya. Improved Learning through better Health, Nutrition and Education for the School-Age Child.
4. United States Agency for International Development (USAID) /Hope for African Children (HACI) (2010) Promoting Early Childhood Development for Orphans and vulnerable children in Resource Constrained settings. The 5x5 Model.
5. United Nations on HIV/AIDS (UNAIDS) (2010) Halting the pandemic, Nairobi, Kenya.
6. United Nations on HIV/AIDS (UNAIDS)/WHO (2009) AIDS in Africa. Three Scenarios to 2025, Joint Nations Programme on HIV/AIDS.
7. Cox A, Horii T, Granby B and Morgan B (2006) The Importance of Early Childhood Development: Assessing the quality of care in Uganda. Masters in International Development, Capstone Project. GWU and CARE/HACI, 21-28.
8. Grantham-McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L, et al. (2007) Development Potential in the first five years for children in developing countries. *Lancet* 369: 60-70.
9. Hamadani J, Huda S, Khatun F, Grantham-McGregor SM (2006) Psychosocial stimulation improves the development of undernourished children. *J Nutri* 136: 2645-2652.
10. Kenya Demographic and Health Survey (2003) Nutritional Status of children. National Council for Population and Development, Nairobi, Kenya. 164-170.
11. Kenya Demographic and Health Survey (2009) Nutritional Status of children. Preliminary report September. USAID Calverton, Maryland, USA.
12. Lindblade KA, Odhiambo F, Rosen DH, DeCock K (2003) Health and nutritional status of orphans <6 years old cared by relatives in Western Kenya. *Trop Med Int Health* 8: 67-72.
13. Young H, Jaspars S (2006) The meaning and measurement of acute malnutrition in emergencies. A primer for decision-makers. The humanitarian practice network. United Kingdom.
14. World Food Programme (WFP) (2004) School children nutrition. WFP, London UK.
15. Gillespie S, Mason J, Osman S (1997) Nutrition and Poverty. Geneva, (NNP No.16).
16. World Health Organization (WHO) (2006) WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva.
17. Food and Agriculture Organization (FAO) (2004) Human energy requirements. Report of a joint FAO/WHO/UNU Expert Consultation, Rome.
18. Nokuthula V (2009) Food consumption in Kenya Masters Dissertation. University of Pretoria.
19. World Food Programme (2010) World Hunger.
20. Maunder E, Matji J, Hatshwayo-Molea T (2001) Enjoy a variety of foods-difficult but necessary in developing countries. *South Afr J Clin Nutr* 14: 7S-11S.
21. Ministry of Health (MoH) / United Nations International Children's Education Fund (UNICEF)(2001) Anemia and status of iron, vitamin A and Zinc in Kenya. Inc. The 1999 National micronutrient survey report.
22. United Nations International Children's Education Fund (UNICEF) (2008) Water, Sanitation, and Hygiene Annual Report.
23. Krause M, Mahan L (1984) Food nutrition and diet therapy. Saunders Company, London.
24. Gibson R, Hotz M (2001) Dietary diversification/modification strategies to enhance micronutrient content and bioavailability of diets in developing countries. *Br J Nutr* 85: s159-s166.
25. Anita T (2002) Food and Nutrition Oxford University press.
26. Pivik R, Dykman R (2007) Event -related variations in alpha band activity during an attention task in pre-adolescents. Effect of morning nutrition. *Clin Neurophysiol* 118: 615-632.
27. C-SAFE/WFP (2004) Regional Analysis, prepared by Tongo International.
28. Ainsworth M, Semali J (2000) The impact of adult deaths on children's health in North Western Tanzania. Policy research working paper.
29. Morris S, Flores R, Olinto P and Medina J (2004) Monetary incentives in primary health care and effects on use and coverage of preventive health care interventions in rural Honduras: cluster randomized trial, *Lancet* 364: 2030-2037.
30. Van Lieshout M, West C (2004) Introduction to malnutrition. In micronutrient malnutrition course for Southern Africa. ARC- Animal nutrition and Animal Production Institute, Pretoria, Centre for nutrition, University of Pretoria, Pretoria, Micronutrient initiative education, Hellen Keller International, Dakar, Bangladesh In cooperation and with support from Ghent University, Belgium. Pg. 24-27.
31. Cooper A, Page A, Foster L, Qahwaji D (2003) Commuting to school. Are children who walk more physically active? *Am J Prev Med* 25: 273-276.
32. Stratton R, Green C, and Elias M (2003) Disease-Related Malnutrition: An Evidence-Based Approach to Treatment. CABI Publishing press: Wallingford 824.
33. Mbithe D, Judith KO, Judith NW, John OA (2008) Promoting nutrition education intervention in rural and urban primary schools in Machakos District, Kenya. PhD Dissertation, Kenyatta University, Nairobi Kenya.
34. Meme M, Kogi-Makau W, Muroki M, Mwadime, K (1998) Energy and protein intake and nutritional status of primary school children 5 to 10 years of age in schools with and without feeding programmes in Nyambene district, Kenya.
35. Parraga IM, Assis AM, Prado MS, Barreto ML, Reis MG, et al. (2000) Gender differences in growth of school-age children with schistosomiasis and geohelminth infection. *Am J Trop Med Hyg* 55: 150-156.
36. Panpanich R, Brabin K, Gonania A, Graham S (1999) Are orphans at increased risk of malnutrition? *Annals of tropical pediatrics: International child health* 19: 279-285.