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NUTRITION STATUS AND ASSOCIATED MORBIDITY RISK FACTORS AMONG ORPHANAGE AND NON-ORPHANAGE CHILDREN IN SELECTED PUBLIC PRIMARY SCHOOLS WITHIN DAGORETTI NAIROBI, KENYA
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E. W. MWANIKI, A.N. MAKOKHA and J. N. MUTTUNGA

ABSTRACT

Background: Most of the nutritional surveys that have been carried out in Kenya have concentrated on children aged five years and below who are under the care of their parent(s). The 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, leaving their children orphaned and vulnerable. This has led to mushrooming of orphanages to take care of these orphans and vulnerable children in Kenya.

Objective: Compare the nutrition status and associated risk factors of primary school children living in orphanages and those not living in orphanages in selected public primary schools in Dagoretti Division, Nairobi.

Design: Descriptive cross sectional survey.

Setting: Four public primary schools in Dagoretti Division. Data were collected from school registers and directly questioning the students, parents/guardians or caretakers.

Subjects: Four hundred and sixteen, four to eleven year olds randomly selected orphanage and non-orphanage children who attended the same primary school.

Results: The orphanage children had a significantly higher rate of stunting and underweight ($p < 0.05$) than the non-orphanage children. The orphanage children had also a significantly higher rate of morbidity ($p < 0.05$) than the non-orphanage children. The orphanage children were more than three times more likely to take inadequate calories compared to the non-orphanage children.

Conclusions: The main factors associated with the higher rate of malnutrition among orphanage children were high morbidity rate, inadequate amounts and diversity of foods served, low rates of vaccination and basic hygiene.

INTRODUCTION

The situation of Orphans and Vulnerable Children (OVC) in Kenya has continued to be of national and international concern. Although no comprehensive survey has been carried out, the Government estimates that there are a total of 2.4 million OVCs in Kenya out of which 1.15 million are as a result of HIV AIDS (1). Orphans and vulnerable children are often more prone to malnutrition and infections and less likely

to receive healthcare than other children (2). This is so especially with the very young children who are likely to suffer from lack of care, and die unnecessarily of malnutrition and respiratory infections (3).

School-age children are particularly vulnerable to under nutrition as the priority in nutrition interventions is often to prevent malnutrition during foetal development and the first years of life – the most critical period for growth and development (4). Stunting and wasting are also wide spread

among school-age children in developing countries (5). High levels of stunting among children suggest that there will also be a long term deficit in mental and physical development that can leave children ill prepared to take maximum advantage of learning opportunities in schools. 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 (6). 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 (7). A study carried out in Malawi established that the prevalence of malnutrition in orphanage children (≤ 6 years old) was 55 % compared with 30 % of non-orphanage children (8). Among the orphanage children, 64 % were stunted compared with 46 % of the non-orphanage children.

Illness of children in the last one month was reported to be higher in the orphanage group, especially diarrhoeal disease, which occurred 30% compared with 7% of non-orphanage children. Orphanage girls were more likely to be malnourished than orphanage boys. Children who had been admitted to an orphanage for more than one year were less malnourished (9). A recent study in Botswana found that orphanage children were 49% more likely to be underweight than non-orphanage children (10).

In Zimbabwe a strong association was found between living in an orphanage and nutritional and health outcomes such as diarrhoea, acute respiratory infection, and underweight status among five to ten year old children. In the same study orphanage children were more wasted (9%) compared to non-orphanage group (2%). In both groups there was a negative and significant relationship between child's age and wasting, stunting and underweight. However among the older children, age had a significant and positive relationship with stunting (3).

This study therefore seeks to determine the adequacy of the care given to the orphanage children in comparison to the non-orphanage children in public primary schools in Dagoretti Division, Nairobi Kenya and the extent to which it is able to foster good nutritional status and basic hygiene.

MATERIALS AND METHODS

Study setting: The study was conducted in Dagoretti Division which is within Nairobi Province. Dagoretti Division lies in the extreme Western Division approximately 20 km from Nairobi City. It consists of several unplanned settlement namely Dagoretti Corner, Congo, Wanyee, Githembe, Ngando, Lenana, Waithaka and Gachui Village. The area has twenty one orphanages but only six are registered with the Government of Kenya. It is estimated that 30% of the

total population comprises of long-term residents, while 70% have moved into the community from other areas (11). The area's demographics are characterised, amongst others, by a very rapid population growth above the norm for Kenya, which has exerted increasing pressure upon the basic resources of land, housing, water and electricity supply. This, in turn, has contributed to under-nutrition, poor sanitation and low levels of environmental health.

Social-demographic information: A structured questionnaire was used to collect demographic data which included, age, sex and educational level of the non-orphanage children's parents and caretakers of the orphanage children.

Study Subjects: This cross sectional study was conducted between November 2009 and February 2010 in 416 children aged between four to eleven years in four public schools. Four settlements were randomly selected from the existing eight. From each settlement a school was randomly selected. These schools are registered public schools run by the government. Information from the schools' registers was used to stratify the children by sex and age and random number tables used to select the sample. Each non-orphanage child was matched to an orphanage child by sex and age. Children who attended these primary schools in the selected area and were four to eleven years old were included in the study sample.

Whereas children for whom consent was not given, those who were absent from school during the study period, those who suffered from chronic illness and orphanage children who were not full time residents including those who were in boarding schools were excluded from the study sample.

Nutrition and Anthropometry: The foods consumed were classified into relevant food groups that were used to calculate food diversity. These food groups were cereals, legumes, vegetables, meat, dairy, fruits, root and tuber crops and plantains. A minimum of four food groups was considered as adequate diversity. The 24 hour recall was used to obtain the foods consumed for breakfast, lunch and supper. Amounts of foods/meals served were approximated using standard cups, plates and measuring jug. The children were visited in their homes/orphanages so that the researcher could administer the questionnaire to their mothers/caretakers to obtain and record the 24-hour dietary recall information. All the ingredients in the meals and their weights were recorded. The ingredients of the packed school lunch were also recorded. Participants were asked to estimate the child's intake of a specified food using standard cups and plates and measuring jug. The utensil used to serve the child was displayed and the extent to which it fills was explained before the approximations were made. The combined caloric

contributions of breakfast and supper (two meals consumed at home) were also computed using the Nutri-Survey programme. The adequacy of caloric intake was expressed as the proportion of the total daily caloric intake. Food tables were used to estimate the adequacy of the energy food consumption. Frequency of washing hands with water and soap at critical times was assessed. Children below six years of age were excluded to improve reliability of the self-reported hygiene practices.

Anthropometric data, which included, height, weight and age was collected from the orphanage and non-orphanage primary school children. Date of birth was obtained from the schools' 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 (12). 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 which was used to test the differences in prevalence of malnutrition indices (stunting, wasting, and underweight), morbidity and the differences in proportion of children washing hands at critical times between orphanage and non-orphanage children. The t-test for proportions was also used to

test the differences in morbidity among vaccinated orphanage and non-orphanage children. The t-test for independent samples was used to test differences between means of food consumption. This test was suitable because the sample was randomly selected. Multivariable analysis was used to determine which group of children was at a higher risk of malnutrition. This relationship was assumed to be linear. 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 parents or guardians/caretakers of the 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 and from Kenya Medical Research Institute Ethical and Review Board.

RESULTS

Demographic characteristics of the children: The sample consisted of children who were equally (50%) distributed between age four to seven years and eight to eleven years, orphanage and non-orphanage children. These age categories of children are susceptible to malnutrition and still need care and supervision, particularly in matters of personal hygiene. The ratio of boys to girls was 1:1 and the total number of children was 416 Table 1.

Table 1
Distribution of children by age, sex and school

		Orphanage (n = 208)		Non-orphanage (n = 208)	
		n	%	n	%
Primary Schools	Jamhuri	51	24.6	51	24.6
	Rafiki	51	24.6	51	24.6
	Waithaka	54	25.8	54	25.8
	Grace	52	25	52	25
Age in years	4-7	104	25	104	25
	8-11	104	25	104	25
Sex	Boys	104	25	104	25
	Girls	104	25	104	25

Diversity of foods: A total of 63 and 37 food items were consumed by the non-orphanage and orphanage children respectively. Only 7.2% of orphanage children consumed more than three food groups

compared to 45.2% of non-orphanage children. 92.9% of orphanage and 54.8% of non-orphanage children consumed less than four food groups. These differences were significant ($p < 0.05$).

Energy intake: The total mean energy intake among the non-orphanage children was 1890 Kcal per day and was significantly higher ($p < 0.05$) than that of the orphanage children Table 2. Further, the intake of energy by orphanage children who took lunch was 1547 Kcal and was significantly lower ($p < 0.05$)

compared to the energy intake of non-orphanage children who also took the three meals of the day. The mean energy intake of orphanage children who did not take lunch was less than half of that of the non-orphanage children.

Table 2
Energy intake among orphanage and non-orphanage children

Meal	Mean energy intake (Kcal)		Percent contribution %		p-value
	Non-orphanage children (n=208)	Orphanage children	Non-orphanage children	Orphanage children	
Breakfast	193 (± 15.3)	173 (± 2.3) (n=208)	10.2	11.2	0.296
Lunch	841 (± 59.6)	679 (± 35) (n=104)	44.5	43.9	0.000***
Supper	856 (± 111.2)	695 (± 31.4) (n=208)	45.3	44.9	0.000***
Total	1890 (± 64.3)	1547 (± 24.9) (n=208)	100 (with lunch (without lunch)	100	0.000***
		868 (± 1.00) (n=104)			0.000***

Malnutrition: Orphanage children had a significantly higher rate ($p < 0.05$) of stunting and underweight than non-orphanage children as shown in Table 3.

Table 3
Prevalence of malnutrition among orphanage and non-orphanage children

Overall malnutrition (Z score ≤ -2.00)	Orphanage children (n=208)		Non-orphanage children (n=208)		Total (N=416)		p-value (t-test)
	n	%	n	%	n	%	
Stunting	98	47.2	51	24.5	149	35.8	0.000***
Underweight	69	33.2	31	14.9	100	24.0	0.000***
Wasting	19	9.2	20	9.7	39	9.4	0.866

Morbidity: The children in the three orphanages and non-orphanage suffered from various infections whose symptoms included colds/flu, diarrhoea, fever and others (vomiting and skin rashes). The morbidity rate was higher among orphanage than non-orphanage children Table 4. The orphanage children had significantly ($p < 0.05$) higher prevalence of diarrhoea and cold/cough compared to the non-orphanage children.

Table 4
Prevalence of morbidity among orphanage and non-orphanage children

Morbidity symptoms	Orphanage children (n=208) n (%)	Non-orphanage children (n=208) n (%)	p-value (t-test)
Diarrhoea	24 (11.5%)	5 (2.4%)	0.015*
Cough/colds	26 (12.5%)	6 (2.9%)	0.014*
Fever	3 (1.4%)	2 (0.5%)	0.800
Others	16 (7.7%)	2 (0.5%)	0.006**
Total	69 (33%)	15 (7%)	0.000***

Vaccination: Among the non-orphanage children 192 (92%) were vaccinated compared to 144 (69%) of the orphanage children Table 5. Girls age four to seven years and eight to eleven years had the lowest (8.3% and 13.9%) proportion of the vaccinated orphanage children. There was a significantly lower rate ($p < 0.05$) of vaccination among orphanage girls aged four to seven years compared to the non-orphanage girls of the same age.

Table 5
Vaccination among orphanage and non-orphanage children

	Sex	Orphanage children	Non-orphanage children	p-value		
		(n = 144)	(n = 192)	n	%	
4-7 years	Boys	61	42.4	71	37.0	0.3194
	Girls	12	8.3	22	11.5	
8-11 years	Boys	51	35.4	69	35.9	0.9216
	Girls	20	13.9	30	15.6	

Basic hygiene: Of the orphanage children, 48% reported washing hands after visiting the toilet the day before the interview compared to 78.2% of the non-orphanage children. 49.4% of the orphanage children and 78.2% of non-orphanage children washed their hands before meals.

There was also a higher proportion (76.3%) of non-orphanage children who reported washing hands with soap during the critical times compared with the orphanage children (12.8%). These differences

were significant at $p < 0.01$

To determine whether the orphanage children were at increased risk of malnutrition compared to non-orphanage children, multivariate analysis was performed. Table 6 shows that the orphanage children had 3.9 times higher risk of consuming inadequate calories compared to non-orphanage children. The risk of stunting and underweight was 2.8 and 1.6 higher among the orphanage children compared with the non-orphanage children respectively.

Table 6
Multivariable analysis of determinants of malnutrition

Factor	Estimated B	S.E of estimate	p-value	Odds Ratio
Sick				
Orphanage	1.46	0.466	0.037	1.24
Non-orphanage	—	—	—	1.000
Immunised				
Orphanage	-1.59	0.416	0.015	1.8
Non-orphanage	—	—	—	1.000
Hand washing with soap				
Orphanage	-0.17	0.133	0.019	2.1
Non-orphanage	—	—	—	1.000
Variety of foods: ≥ 4 food groups				
Orphanage	-0.80	0.118	0.000	2.23
Non-orphanage	—	—	—	1.000
Energy intake: Inadequate				
Orphanage	1.39	0.121	0.000	3.93
Non-orphanage	—	—	—	1.000
Stunting				
Orphanage	1.73	0.313	0.028	2.8
Non-orphanage	—	—	—	1.000
Underweight				
Orphanage		2.09	0.498	0.043
Non-orphanage	—	—	—	1.000

DISCUSSION

Hunger and malnutrition among children in developing countries continue to impair health, quality of life, and survival. Educational level and socio-economic status of the children's parents, the differences in the school environment could represent a source of bias. However this study demonstrates that consumption of limited varieties and diversity of foods, inadequate energy intake, low rates of immunisation and hand washing at critical times and the high prevalence of disease among the orphanage children as factors that could have contributed to the high prevalence of malnutrition among the orphanage children.

In this study non-orphanage children had significantly ($p < 0.05$) higher diversity of foods served than the orphanage. The orphanage children were also more than twice less likely to consume foods from more than four food groups compared to non-orphanage children. Data from the study showed that diet in the orphanage consisted of 37 different foods compared to the non-orphanage diet which consisted of 63 different foods. The orphanage 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 compared to 54.8% of the non-orphanage children. Only a small (7.2%) proportion of the orphanage children were served meals with four or more food groups compared with the non-orphanage (45.2%) group. This results are similar to a Pakistan study which found 6.5% of orphanage children and 42.2% of non-orphanage children consumed four or more food groups respectively (1).

Conversely, another study in Western Kenya found that all the children in the study consumed four or more food groups (13). The consumption of a varied diet is associated with increased intake of energy and better health (14). Children may be served with large servings of starchy cereals because they are bulky thus giving satiety value.

The results showed that many of the children had three meals per day. 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. However the non-orphanage children were served with three meals in a day throughout the week. For the orphanage group even for the children who took lunch, the overall energy intake did not improve much, as indicated by the study data: with lunch 1547 Kilo calories, without lunch 869 Kilo calories.

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 (15). 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 (16). 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 than the non-orphanage children. A study in North Western Tanzania found higher stunting levels among orphanage children than among non-orphanage children (17). 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 significantly high prevalence rate ($p < 0.05$) 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 insufficient 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 (6). However children can exhibit catch up growth if the environment improves (7). This could imply that the orphanage did not offer a conducive environment that could improve the children's nutritional status.

The orphanage children were more likely to be underweight than their counterpart. These findings concur with the study in Botswana which found that orphanage children were (49%) more likely to be underweight than non-orphanage children (10).

Deteriorating standards of living, disease

prevalence and increase in food prices could have contributed to the high prevalence of under nutrition. A child's Weight-for-Age measure reflects both previous growth and present nutritional conditions. Hence the high rate of underweight reflects the presence of both long term chronic malnutrition and recent food insecurity or illness. Underweight among school children can reflect prenatal under nutrition, infection and possibly inadequate attention by care givers (18). This could imply that children in the orphanage were more 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 (19). The orphanage children walked to and from school daily (an average of six Kilometers) and this may have enhanced their physical activity thus increasing their energy requirement (20). They may also have suffered episodes of disease.

Prevalence of morbidity was significantly ($p < 0.05$) higher among the orphanage children compared to non-orphanage children. The orphanage had 1.2 higher risk of being sick compared to the non-orphanage children. Increased risk of morbidity most likely contributed to the increased risk of stunting among the orphanage children. These findings are similar to the findings of UNICEF which found synergy between malnutrition and disease prevalence (1).

Nutritional deficiencies increase the risk of the child suffering from infectious diseases such as diarrhoea, fever and malaria and these illnesses in turn contribute to worsened nutritional status through loss of appetite or nutrient loss during the course of illness (8). Under nutrition tends to weaken a child's resistance to disease and this interactions are especially evidenced in diarrhoeal disease. Morbidity breeds malnutrition and in turn, malnutrition increases morbidity, thus establishing a vicious cycle (21). Repeated bouts of diarrhoea have far reaching consequences leading to growth failure and malnutrition. Diarrhoea in children results mainly from unsafe water and neglect of personal hygiene. High prevalence of disease among the orphanage children could be due to inadequate sanitation facilities in the orphanage. It could also have resulted from the low rates of hand washing with soap.

There was a significantly lower rate ($p < 0.05$) of vaccination among orphanage children compared to the non-orphanage children. The orphanage vaccination rate was similar to that of a study carried out in Kenya, where 62.7% of primary school children (6-13 year old) had BCG scars present (22). These findings for orphanage children are also consistent with those by UNICEF, National immunization

coverage where only 76 per cent of primary school children were vaccinated, far below the recommended 85 per cent in 2008 (1). Ignorance and or negative attitudes among caregivers may have led to lack of adherence of some children to immunisation schedule exposing the children to infections.

Orphanage children were twice less likely to wash hands at critical times compared to non-orphanage children. Only 48% of the orphanage compared to 78% of non-orphanage children washed hands after visiting the toilet the day prior to the interview.

The non-orphanage rates are similar to those of studies conducted in Colombia and India which reported that 82.5% and 86.4% of students, respectively, washed their hands after using the toilet (1). The findings for both orphanage and non-orphanage were different from those of the study in Ethiopia which reported that only few (14.8%) of the school children washed hands after visiting the toilet (23).

Of the orphanage children 49% compared to 78% of the non-orphanage children reported washing hands before meals. The orphanage rate is consistent with the findings of a study in Colombia which reported 46.9% of school children washed hands before meals. The non-orphanage rate was similar to 75.9% rate reported among school children in the Philippines study (24). Only 13% of the orphanage children compared to 76.4% of the non-orphanage children washed hands with soap.

These rates are different from the Ethiopian study which reported 36.2% rate (23) and the Philippines and Turkey studies where an average of 37.7% and 42.4% of children, respectively, washed their hands with soap (24). Observed rates of hand washing with soap at critical moments range from zero per cent to 34 per cent (25). Orphanage children's rates are similar to rates in Kenya which stand at five percent (25). Hand washing at critical times - including before eating or preparing food and after using the toilet can reduce morbidity due to diarrhoea in children by almost 50 per cent (25). Low personal hygiene is associated with increased morbidity, which in turn is associated with decreased nutritional status (21).

Absence of taps positioned strategically, for example, near the orphanages' dining area, which could serve as a reminder to the orphanage children to wash their hands before meals coupled with rationing of water could have contributed to these results among the orphanage children. Hand washing with soap is the single most cost-effective intervention for prevention of diarrhoeal related deaths and disease (26). Although the children may have known that washing hands after using the toilet is important, they may have been negatively influenced by factors such as laziness, the rush to play with friends, or even the lack of hand washing facilities close to the latrines. The low frequencies of hand washing among the

orphanage children with soap may be attributed to the lack of soap in school and at the orphanage.

LIMITATIONS OF THE STUDY

Longitudinal study could have enabled study subjects to be profiled overtime.

Hygiene practices could have been over reported as is common with self-reported hygiene practices. Educational level and socio economic status of the children's parents, the differences in the school environment could represent a source of bias.

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REFERENCES

1. United Nations International Children's Education Fund (UNICEF). Water, Sanitation, and Hygiene Annual Report (2009).
2. Cox A, Horii T, Granby B and Morgan B. The Importance of Early Childhood Development: Assessing the quality of care in Uganda (2006). Masters in International Development, Capstone Project. GWU and CARE/HACI. pg 21-28
3. Young H, and Jaspars S. The meaning and measurement of acute malnutrition in emergencies (2006). A primer for decision-makers. The humanitarian practice network. United Kingdom, London pg. 12 [PubMed]
4. Bundy D, Schaeffer S and Jukes M. School-Based Health and Nutrition Programs. Disease Control Priorities in Developing Countries (2006) (2nd Edition), 1,091-1,108. New York: Oxford University Press.
5. Burbano C, Bundy D, Grosh M, Gelli A, Jukes M and Drake L. Rethinking School Feeding: Social Safety Nets, Child Development and the Education Sector. The International Bank for Reconstruction and Development/the World Bank (2009). Washington DC: page 33-36
6. Gillespie S and Kadiyata S. Rethinking food aid to fight AIDS. International nutrition foundation for United Nations University. Food and nutrition bulletin (2004). Volume. 25 number 3, september 04. United Nations University press. page 33-41
7. World Health Organization (WHO). Children-schools and health; their nutrition and health in Kenya. WHO Global database on child growth and malnutrition (2008). Retrieved from www.schoolsandhealth.org on 24/1/2012. Page. 17-20
8. Lindblade K, Odhiambo D and Decock K Health and nutritional status of orphans <6 years old cared by relatives in Western Kenya. *Journal of Tropical Medicine and International Health* (2003). Blackwell synergy. pg 7-11
9. Panpranish R, Brabin K, Gornania A and Graham S. Are orphans at increased risk of malnutrition? *Annals of tropical pediatrics International child health*. 1999: Pg. 3341S-3352S
10. Mishra V and Bignami S. Orphans and vulnerable children in high HIV-prevalence countries in Sub-Saharan Africa (2008). DHS Analytical studies 15, USAID. Pg. 15
11. Government of Kenya (GOK). Ministry of Planning and National development, Census Report 2009 Kenya population and housing census results. Kenya National Bureau of Statistics, GOK Printers(2010), Nairobi. 5-11
12. World Health Organization (WHO). WHO Child growth standards length/height for age, weight for age, weight for length or height and body mass index for age methods of development. WHO (2006). Geneva. Page 43
13. Nokuthula V. Food consumption in Kenya (2009). University of Pretoria 73-84
14. Gibson R, and Hotz M. Dietary diversification/ modification strategies to enhance micronutrient content and bioavailability of diets in developing countries. *Brit. J. of Nutrit.* 2001; **85**: s159-s166
15. Anita T. Food and Nutrition (2002). Oxford University press. 123-151, 200-248
16. Pivik R and Dykman R. Event-related variations in alpha band activity during an attention task in pre-adolescents. Effect of morning nutrition. *Journal of clinical Neurophysiology* 2007; **178**: 615-632
17. Ainsworth M and Semali J. The impact of adult deaths on children's health in North Western Tanzania (2000). Policy research working paper No. 2266 World Bank Washington D.C pg 301-321
18. World Food Programme. Hunger (2010), Accessed online: <http://www.wfp.org/hunger/faqs>. page 82
19. Van Lieshout M and West C Introduction to malnutrition. In micronutrient malnutrition course for Southern Africa. ARC- Animal nutrition and Animal Production Institute, Pretoria, Centre for nutrition, (2004). University of Pretoria, Pretoria, Micronutrient initiative education, Hellen Keller International, Dakar, Bangladesh In cooperation and with support from Ghent University, Belgium. Page. 24-27
20. Cooper A, Page A, Foster L and Qahwaji D. Commuting to school. Are children who walk more physically active? *Am J Prev Med.* 2003; **25**: 273-276.
21. Nematian J, Nematian E, Gholamrezanezhad A and Asgari A. Prevalence of intestinal parasitic infections and their relation with socio-economic factors and hygienic habits in Tehran primary school students. *Acta Trop.* 2004; **92**: 79-86.
22. Kwamanga D, Githui W, Agwanda R and Nderitu P. BCG scar survey among primary school children in Kenya (1986-1990). Respiratory Disease Research Unit, Kenya Medical Research Institute, Nairobi. *East Afri. Med. J.* 1993; **70**: 68-71
23. Neumann C, Harris D and Rogers L. Contribution of animal source food in improving diet quality and function in children in the developing world (2002). *Nutrition Research*; **22**: pg 193-220

-
24. Lopez-Quintero C, Freeman P and Neumark Y. Hand washing among school children in Bogota, Colombia. *Am J Public Health* (2009). 99: pg94–101. PMC free article PubMed
 25. World Health Organization (WHO). Towards the realization of free basic sanitation: Evaluation, Review and Recommendations (2010). WRC Project NOK. Pg1743-1520
 26. World Bank. Hygiene, sanitation and water in schools (2005): Gender roles and impact. Retrieved from www.schoolsanitation.org/basic-principles on 16/8/2011. Pg.103