Under-nutrition and its association with psychosocial and academic performance in pre-school children in Asembo, Siaya County, Kenya

Terry Komo[1], Daniel Mokaya[2], Caroline Musita[3]

[1] School of Public Health, Jomo Kenyatta University of Agriculture and Technology, P.O BOX 62000-00200 Nairobi Kenya

[2] School of Public Health, Jomo Kenyatta University of Agriculture and Technology, P.O BOX 62000-00200 Nairobi Kenya

[3] School of Public Health, Jomo Kenyatta University of Agriculture and Technology, P.O BOX 62000-00200 Nairobi Kenya

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Abstract- Nearly half of all deaths in children under 5 are attributable to under-nutrition. This translates into the unnecessary loss of about three million lives a year. Under nutrition puts children at risk of dying from common infections, increases the frequency and severity of such infections, and contributes to delayed recovery. Under-nutrition has been associated to poor cognitive development, poor academic performance and adversely affects social skills in children.

This study sought to establish the prevalence of under nutrition in children 3-5 years of age enrolled in nursery schools within Asembo in Siaya County, to assess factors associated with under nutrition and to establish the association between under-nutrition and the psychosocial and academic performances of the children.

This was a school-based cross-sectional study. The dependent variables were stunting, wasting and underweight. The independent variables included: Demographic status, socio-economic status, immunization status and child morbidity and WATSAN practices. Association was sought between under-nutrition and psychosocial and academic performance of the children.

Anthropometric measurements were obtained by use of standardized weighing scale and height board. Interviews were conducted using a structured questionnaire to obtain child and household data from the care givers. Data on the school characteristics of interest was obtained through a one on one interview with the nursery school head teachers and also through observation. The psychosocial performances of the children were obtained from the teachers and scores entered in a 5 point likert item and were later collapsed into fail or pass. The academic performances were obtained from end of term examinations categorizing the scores into pass or fail, while children school attendance data was obtained from class registers.

Univariate and Bivariate logistic regression analyses were used to determine factors associated with under-nutrition while Poisson regression, reporting prevalence ratios was used to determine association between under- nutrition and psychosocial and academic performance.

The combined prevalence for under-nutrition was 15.13%. The prevalence of wasting, stunting and underweight was 2.63%, 9.21% and 3.29% respectively. Children who had had diarrhea 2 weeks prior to interview, had 8.72 more odds of being wasted and 7.38 more odds of being underweight than those who did not have diarrhea 2 weeks prior to interview. Children from the richest quintile had 0.67 less odds of being stunted than children from the poorest wealth quintile. Wasting was found to have statistical significant association with comprehension and absenteeism from school. None of the other parameters were significantly associated with either psychosocial or academic performance.

Index Terms-Academic performance, pre-school children, psychosocial performance, under-nutrition

INTRODUCTION

According to the WHO classification of child under nutrition, children with a Z-score below -2 SD of the Weight for Height (WHZ), Height for Age (HAZ) and Weight for Age (WAZ) are classified as wasted, stunted and underweight respectively. [1]

Stunting represents past or chronic malnutrition or illness, but is less sensitive to temporary food shortages. Wasting is sensitive to temporary food shortages and episodes of illness and commonly used as an indicator of current nutritional status. Underweight reflects the cumulative and acute exposures. [2]

Malnutrition is one of the major public health problems all over the world. Worldwide, 165 million children below five years of

age are affected by under-nutrition. Currently it is associated with more than 41% of the deaths that occur annually in children from 6 to 24 months of age in developing countries, which is approximately 2.3 million deaths, and an estimate of 60% of 10.9 million annual deaths among children under 5 years old in low-income and middle income countries. Out of the 165 million children affected with under-nutrition worldwide, 26% were stunted. Stunting was at 36% in Africa and 27% in Asia. More than 90% of stunted children in the world have been living in Africa and Asia. An estimated 80% of world's stunted children live in just 14 countries including Kenya. [3] The burden of child under-nutrition is unsurprisingly greatest in the world's poorest countries, especially in SSA and Asia. This is a highly salient issue in Kenya, which is among the 20 countries that account for 80% of the world's chronically undernourished children. [4]

Malnutrition among Kenya's children is a serious problem and exists throughout the country. Annually, more than 70,000 Kenyan children die before their 5th birthday; malnutrition contributes to about half of these deaths. According to the Kenya Demographic Health Survey (KDHS) of 2014, 26% of children under five were stunted in Kenya. 11% of children did not weigh enough for their ages while 4% were wasted. [5]

The causes of childhood malnutrition are diverse, multidimensional and interrelated. An analytical framework suggested by the United Nations Children's Fund (UNICEF) categorizes the cause into a) immediate causes: inadequate dietary intake and illness b) underlying causes: insufficient access to food in a household; inadequate health services and unhealthy environment; and inadequate care for children and women at the household level and c) basic causes: insufficient current and potential resources at social level. In sub-Saharan Africa, various indicators of social economic status have been associated with children's nutritional status such as maternal and paternal educational level, parental income, and family assets. [6]

Malnutrition among children in developing countries is a major public health concern since it places a heavy burden on already disadvantaged communities. [7] Disease and malnutrition are closely linked; sometimes disease is the result of malnutrition, sometimes it is a contributing factor. Malnutrition prevents children from reaching their full physical and mental potential. Health and physical consequences of prolonged states of malnourishment among children are: delay in their physical growth and motor development, lower intellectual quotient (IQ), greater behavioral problems, deficient social skills and increased susceptibility to contracting diseases. [8]

Adequate nutrition is essential during childhood to ensure healthy growth, proper organ formation and function, a strong immune system and neurological and cognitive development. Nutritional status has a major impact on children's survival mainly due to the synergistic relationships between malnutrition and diseases. Linear growth retardation (stunting) is frequently associated with repeated exposure to adverse economic conditions, poor sanitation, and the interactive effects of poor nutrient intake and infection. [1]

Nutrition is an endogenous factor that affects the learning ability and skills of children at school. The relationship between nutrition and school performance has been an interest to many researchers due to the frequent observation of poor school performance among malnourished students. Cognitive development and brain physiology among children requires access to sufficient and nutrient rich foods. Malnutrition adversely affects school attendance, academic performance and social skills among children. [9]

Stunted children are about 20% less likely to read a simple sentence by age of 8; they are about 15% less likely to be in their right grade for their age and go on to earn 20% less as adults compared to those who were well-nourished.[10] Children with a history of stunting are at risk of cognitive and learning delays. Many cross sectional studies of high risk children have noted associations between concurrent stunting and poor preschool progress or cognitive ability. Stunted children, compared with non stunted children were less likely to be enrolled in school, more likely to enroll late, to attain lower achievement levels or grades for their age and have poorer cognitive ability or achievement scores. [11] In a study conducted in Southeast Asian children, children with low weight for age were 3.5 times more likely to have a non-verbal IQ<89. The chance of having non-verbal IQ<89 was also doubled with low height for age. [12]

Causes of child malnutrition are diverse and change in space and time. Investigating the current determinants of malnutrition remains a vital process in designing effective intervention strategies.

One of the challenges faced in trying to implement policies which have been put in place to curb malnutrition in Kenya is the low understanding of linkage between national food security, basic education, water and sanitation strategies on one hand and nutrition on the other. As a result, there is need to sensitize policy makers and programmers on the causal factors of malnutrition and influence them to address malnutrition in a holistic approach and broad manner. [13] More so, many studies done major on home characteristics and none have explored the facts that many of the preschoolers spend most of their time in school and some of the characteristics that contribute to malnutrition in the home environment may also be present in the school environment.

There is little empirical evidence on the effect of childhood malnutrition on children's cognitive achievements in low income

countries. This study aimed to establish the association between under nutrition and psychosocial development and academic performance and thus build up on the knowledge bank of the topic in low income countries.

METHODS

Study site

The study was a school-based cross-sectional study conducted within Asembo in Siaya County in Kenya.

Study variables

The study variables were**: Demographic characteristics**; Age of household members, gender and marital status of caregiver, **socioeconomic status**; education level of caregiver, main source of income and a wealth index(livestock ownership, house ownership, types of wall, types of roof, types of floor, types of toilet, main source of fuel and main source of drinking water, **child morbidity and immunization status**; Diarrhea incidence and other morbidities in the last two weeks prior to interview and child immunization status, **WATSAN**; Drinking water treatment practices, presence of a latrine/WC and availability of hand washing facilities, **nutritional status**; WHO Z-scores**, academic performance**; school attendance and examination scores for language and arithmetic, **psychosocial performance**; comprehension levels, attentiveness in class and child interaction with others.

Sample size calculation and sampling procedure

The study population included all children with 3-5 years of age in nursery schools within Asembo, care givers, class teachers and school heads were also targeted. All children 3-5 years enrolled in nursery schools and who had been in the particular school for at least 3 months prior to the interview were included. Children who were ill or disabled were excluded from the study. The Cochran's sampling formula was used in the calculation of the sample size $n = t^2 * p (q) / d^2$. The critical value (1.96) for a 95% confidence level was used and the prevalence of under-nutrition used was 10.9%; an average of wasting stunted and underweight prevalence as reported for Siaya County in the KDHS report of 2014. The sample size came to 149 and an additional 11 children were added for non-response hence total targeted sample size was 160 children.

There were 42 government nursery schools in Asembo. Asembo is divided into two administrative units namely, Asembo East and Asembo West locations. The two locations formed the two stratas for the study. Asembo East had 22 schools, while 20 were in Asembo west. The study purposively picked 20% of the schools from each stratum. The total number of schools picked was 9; 5 from Asembo East and 4 from Asembo West. A list from the Rarieda Early Children Education office served as the sample frame, having considered distance of a school from the other, to avoid picking schools that were very close to each other. A sample interval of 5 was used for both Asembo East and Asembo West. The number of (3-5) year old children in the schools selected was fairly same; 5 schools had a target of 18 children each, 3 schools had a target of 17 children each and 1 school had a target of 19 children. The sample frame was a list made by the class teachers, of all the children who met the study's criteria. Random sampling was used to pick children from each school; numbers were written up to the last number of children required per school on well-folded pieces of paper and mixed in a box together with blank pieces of paper. The children were asked to pick a piece each and those who picked papers with numbers written on them were selected.

Informed consent forms were then sent to the principal care givers of the children selected to participate in the study. Response was obtained from 95% of the care givers. The distribution of children per school who participated in the study was 16 children each in 5 schools, 17 children in 1 school, 18 children each in 2 schools and 19 children in 1 school.

Invitation letters were sent to all the principle care givers who gave consent to participate in the study and all the 152 principle care givers participated in the study.

Data collection tools

A researcher administered questionnaire was used to collect data from the care givers. The questionnaire had a section where the teachers filled the arithmetic and language test scores and also filled in the pupils' psychosocial scores. School registers were used to obtain data on the school attendance of the pupils.

A calibrated digital weighing scale and a vertical height board were used to measure weight and height respectively.

Pretesting of the questionnaires, weighing scale and height board was done in a nursery school in Asembo; whereby 5% of the sample size was targeted.

Data collection

Data was collected with the help of trained research assistants.

Care givers were invited to the schools where interviews were conducted through a structured questionnaire. Data collected from care givers included: Demographic and socio-economic characteristics, water and sanitation characteristic and child morbidity and immunization data.

The school attendance of the children was established by checking through the class registers with the help of the class teachers.

The academic performance (arithmetic and language skills) of the children was assessed by use of scores from the end of term examinations. The scores were entered into a likert scale tool ranging from very poor to very good; 0-20% very poor, 21-40% poor, 41-60% average, 61-80% good and 81-100% very good. The scores were then categorized into pass; for those with good

and very good and fail; for those with average, poor and very poor.

Psychosocial aspects of the children were assessed through interviewing the class teachers on how the child interacted with other children, comprehension of the children and their attentiveness in class and recorded on a 5-point likert scale ranging from very poor to very good. The scores were then categorized into pass; for those with good and very good and fail; for those with average, poor and very poor performance.

The research assistants obtained data about the school characteristics of interest from the head teachers and also used observation skills for the same. These included: availability of toilets, availability of hand washing facilities and water treatment practices.

Anthropometric measurements were taken following WHO standard anthropometry guidelines. Height was measured to the nearest 0.1 cm by use of calibrated vertical boards, while weight was measured to the nearest 0.1kg by use of calibrated digital weighing machines.

Data management and analysis

Descriptive and inferential statistics were used to analyze and report findings of the study. Data entry was done using excel and analysis was done using STATA.

Weight and height measurement were converted to weight for age z-scores (WAZ), height for age z-scores (HAZ) and weight for height z-scores (WHZ) using the WHO Anthro software. The resulting indices were used to determine the levels of malnutrition. Underweight was defined as WAZ less than -2SD, stunting as HAZ less than -2SD and wasting as WHZ less than -2SD.

Wealth index was computed using principal component analysis using key variables that included; ownership of own house, ownership of livestock, types of walls, types of roofs, types of floors, main source of cooking fuel, types of toilets and main source of drinking water. The resulting wealth index variable was categorized into five quintiles; very poor, poor, medium, rich and very rich.

The association between the indicators of under-nutrition and the dependent variables was determined using univariate and multivariate logistic regression. In the univariate model, all variables with a p-value of < 0.25 were considered to proceed to the multivariate model. The variables were then tested by use of stepwise, backward and forward multivariate models separately. The model which retained most of the variables with p-value of <0.05 significance was used in the final multivariate model.

Association between malnutrition indices and psychosocial and academic performances was tested by the Poisson regression model. Prevalence of under nutrition, odds ratios and prevalence ratios were reported.

Ethical approval

The study protocol was reviewed and approved by a NACOSTI approved Ethical Review Board in Kenya. Permission was sought from the Siaya County Early Childhood Education office to allow the study to be conducted. The protocol and objectives were discussed with the school heads and nursery school teachers for clarification and acceptance. Written and signed informed consent forms were sought from the parents of the sampled children before commencement of the study.

FINDINGS

Demographics and socio-economic characteristics

Age and gender of children

Children in the 48-60 months age category were 96 (63.2%) and males in the age group were 52 (54.2%). Children in the 36-47 months age category were 56 (36.8%) and males and females in the group were 28 (50%) each.

Demographics and socio-economic status of caregivers

Care givers between 20-25 years of age were the majority (38.82%). Care givers aged between 36-40years and over 40 years were at 9.21% and 9.87% respectively. The mean age of the care givers was 29.9 ±8.49 with a range of 20-62 years. Majority (82.2%) of the care givers were married; 7.9% were single, 7.9% widowed and 2.0% were separated. Majority (76.97%) had primary school education only, with 1.97% only, having reached the tertiary level of education.

Table 1: Demographics and socio-economic characteristics of care givers

	N=152	
	n	%
Age in years		
20-25	59	38.82
26-30	37	24.34
31-35	27	17.76
36-40	14	9.21
over 40	15	9.87
Marital status		
Married	125	82.24
Single	12	7.89
Separated	3	1.97
Widowed	12	7.89
Education level		
Primary	117	76.97
Secondary	32	21.05
Tertiary	3	1.97
Occupation		
Unemployed	59	38.82
Farmer	50	32.89
Small business	30	19.74
Formal employment	7	4.61
Casual worker	4	2.63
Fishing	2	1.32

Prevalence of under-nutrition

The prevalence of wasted among the study participants was 2.63%, stunting was 9.21% and underweight was 3.29%. Among children of 48-60 months, wasting prevalence was 4.17% and there was no wasting in 36-47months. In male children, prevalence of wasting was 1.3% and in females, prevalence was at 4.2%. In children 36-47 months, prevalence of stunting was 8.93%, while in 48-60 months, prevalence was 9.38%. Prevalence of stunting in males was 7.5% while in females was 11.1%. Prevalence of underweight in 36-47 and 48-60 months was 3.57% and 3.13% respectively. The prevalence of underweight in male participants was 3.8% and in females was 4.2%.

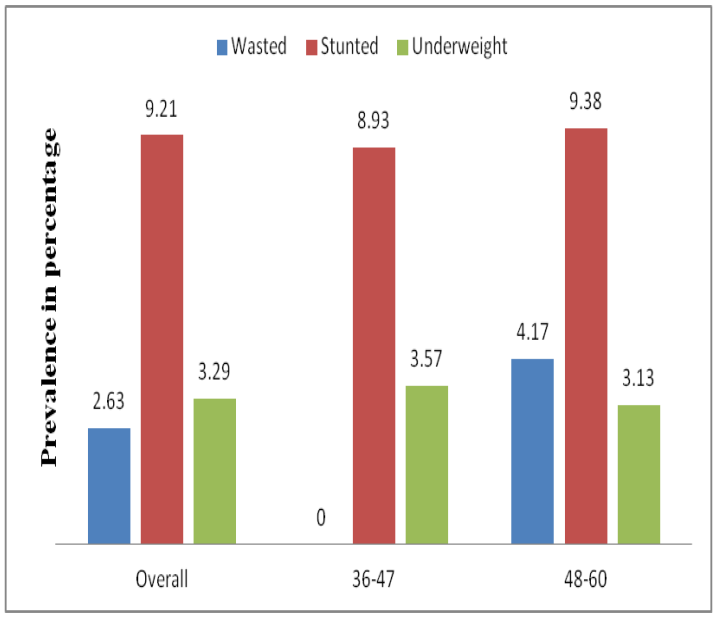

Figure1: Prevalence of under-nutrition in children

Factors associated with under-nutrition

Distribution of key predictors of under-nutrition

Most participants (95.39%) had toilets in their homes and 71.05% of the participants treated their drinking water. 95.39% of the children had completed immunization as reported by their care givers. Only 10.53% of the children were reported to have had diarrhea in the two weeks prior to the interview.

Many of the children (77.63%) were reported to have had at least an illness in the last two weeks prior to the interview.

Diseases mentioned included malaria (47.46%). 5 out of the 9 (55.56%) schools had treated water; the total number of children who had treated water at school was 83(54.61%).

Table 2: Distribution of key predictors of under-nutrition

	N=152	
	(n)	(%)
Household socio-economic status (Wealth index)*		
First quintile	31	20.39
Second quintile	30	19.74
Third quintile	31	20.39
Fourth quintile	30	19.74
Fifth quintile	30	19.74
Household WATSAN		
Availability of toilet	145	95.39
Treatment of drinking water	108	71.05
Child morbidity and immunization status		
Completed immunization	142	93.42
Had diarrhea in the last 2 weeks prior to interview	16	10.53
Had an illness in the past 6 months prior to interview	118	77.63
Malaria	*56*	*47.46*
Flu	*45*	*38.14*
Abdominal pains without diarrhea	*7*	*5.93*
Septicemia	*3*	*2.54*
Measles	*2*	*1.69*
Injuries	*2*	*1.69*
pneumonia	*1*	*0.85*
Boils	*1*	*0.85*
Rashes	*1*	*0.85*
School WATSAN		
Treatment of drinking water	78	51.32
Availability of hand washing facilities	59	38.82
** First quintile is lowest and fifth is richest*		

Factors associated with wasting

In bivariate analysis occupation of care giver (casual worker against farmer), complete immunization of children and diarrhea in the 2 weeks prior to interview, had a p-value of less than 0.25. Only diarrhea in the last two weeks prior to interview was found to be independently and significantly associated with wasting in multivariate analysis. Wasted children had 9.57 more odds of having had diarrhea in the last two weeks prior to the interview than those who were not wasted.

Factors associated with stunting

In bivariate analysis age of caregiver, occupation of care giver and the wealth quintiles had a p-value of less than 0.25.It is only the wealth index that was independently and significantly associated with stunting in the multivariate analysis. Stunted children were more likely to belong to the lower quintiles. Children in the 5th quintile had 33% less odds of being stunted than children in the first quintile.

Factors associated with underweight

Financial independence of the principal care giver, diarrhea in the last two weeks prior to interview and illnesses in the last two weeks prior to interview specifically flu and abdominal pains without diarrhea, had a p-value of less than 0.25. However, it is only diarrhea in the last two weeks prior to interview that was independently and significantly associated with being under weight in the multivariate analysis. Children who were under weight had 6.34 more odds of having had diarrhea in the last two weeks prior to the interview than those who were not underweight.

Table 3: Univariate analysis of factors associated with under-nutrition

	Associated factors	COR	P-value
Wasting	**Occupation**		
	Farmer	**ref**	
	Casual worker	16.33	0.07
	Completed immunization		
	No	**ref**	
	Yes	0.19	0.17
	Diarrhea(last 2 weeks prior to interview)		
	No	**ref**	
	Yes	9.57	0.03
Stunting	**Age of caregiver**		
	20-25	**ref**	
	over 40 years	2.7	0.21
	Occupation of care giver		
	Farmer	**ref**	
	Small business owner	2.88	0.13
	Wealth quintiles		
	First	**ref**	
	Second	0.12	0.05
	Third	0.24	0.09
	Fourth	0.38	0.2
	Fifth	0.12	0.05
Underweight	**Care giver is financially independent**		
	No	**ref**	
	Yes	0.25	0.22
	Diarrhea(last 2 weeks prior to interview)		
	No	**ref**	
	Yes	6.33	0.05
	Morbidity(2 weeks prior to interview)		
	Boils	**ref**	
	Flu	3.93	0.24
	Abdominal pains without diarrhea	9.17	0.13

Table 4: Multivariate analysis of factors associated with under-nutrition

	Associated Factors	(Yes#)	(No#)	Crude Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
Wasted	Diarrhea (last 2 weeks prior to interview)	2	14	9.57 (1.25-17.30)	8.72 (1.08-17.59)
Stunted	First quintile	7	24	1	1
	Second quintile	1	29	0.12 (0.01-0.29)	_
	Third quintile	2	29	0.24 (0.04-0.26)	_
	Fourth quintile	3	27	0.38 (0.08-0.64)	_
	Fifth quintile	1	29	0.11 (0.01-0.29)	0.67 (0.44-0.89)
Underweight	Diarrhea (last 2 weeks prior to interview)	2	14	6.34 (5.74-21.76)	7.38 (6.15-24.32)

Association between under-nutrition and psychosocial and academic performance

Wasting was positively associated with poor comprehension and absenteeism from school. None of the other nutrition parameters were significantly associated with psychosocial and academic performance in children.

Association between under-nutrition and psychosocial performance

The prevalence of children with poor attentiveness was 46% higher in wasted children than in non-wasted children. The prevalence of children with poor attentiveness was 20% higher in stunted children than in non- stunted while the prevalence of children with poor attentiveness was 37% lower in underweight children than in non-underweight. None of the associations were statistically significant

The prevalence of children with poor comprehension was 61% higher in wasted children than in non-wasted children (PR 1.61, 95% CI 1.42-1.82). The prevalence of children with poor comprehension was 2% higher in stunted children and 5% lower in underweight children as compared to the non-stunted and non-underweight counterparts.

The prevalence of children with poor interaction with others was 64% higher in wasted children, 79% lower in stunted children and 36% lower in underweight children as compared to non-wasted, non-stunted and non-underweight children respectively.

Table 5: Association between under-nutrition and psychosocial scores

		Fail	Pass	Prevalence ratio	95% Confidence Interval
		Attentiveness			
Wasted	**Yes**	3	1	1.46	0.81-2.63
	No	76	72		
Stunted	**yes**	9	5	1.20	0.79-1.82
	No	74	64		
Underweight	**Yes**	2	3	0.632	0.21-1.86
	No	77	70		
		Comprehension			
Wasted	**Yes**	4	0	**1.61**	**1.42-1.82**
	No	92	56		
Stunted	**Yes**	9	5	1.02	0.68-1.54
	No	87	51		
Underweight	**Yes**	3	2	0.95	0.46-1.96
	No	93	54		
		Interaction			
Wasted	**Yes**	2	2	1.64	0.60-4.51
	No	45	103		
Stunted	**Yes**	1	13	0.21	0.03-1.44
	No	46	92		
Underweight	**Yes**	1	4	0.64	0.11-3.75
	No	46	101		

Association between under-nutrition and academic performance

The prevalence of children with poor arithmetic performance was 28% higher in wasted children, 4% lower in stunted children and 1% higher in underweight children as compared to non-wasted, non-stunted and non-underweight children respectively.

The prevalence of children with poor language performance was 17% higher in wasted children and 25% higher in underweight children as compared to the non-wasted and non-underweight children respectively. There was no difference in the prevalence of children with poor language performance in the stunted or non-stunted groups.

The prevalence of children who had been absent from school at least once in a period of three months was 23% significantly higher in wasted children than in non-wasted children (PR=1.23, 95% CI 1.14-1.33). The prevalence of children who had been absent from school at least once in a period of three months was 19% lower in stunted children and 2% lower in underweight children as compared to non-stunted and non-underweight children respectively.

Table 6: Association between under-nutrition and psychosocial scores

		Fail	Pass	Prevalence ratio	95% confidence interval
		Arithmetic			
Wasted	Yes	3	1	1.28	0.71-2.28
	No	87	61		
Stunted	Yes	8	6	0.96	0.60-1.55
	No	82	56		
Underweight	Yes	3	2	1.01	0.49-2.10
	No	87	60		
		Language			
Wasted	Yes	3	1	1.17	0.66-2.08
	No	95	53		
Stunted	Yes	9	5	1	0.66-1.50
	No	89	49		
Underweight	Yes	4	1	1.25	0.79-1.97
	No	94	53		
		Absenteeism			
Wasted	Yes	4	0	1.23	1.14-1.33
	No	120	28		
Stunted	Yes	8	6	0.81	0.50-1.28
	No	98	40		
Underweight	Yes	4	1	0.98	0.63-1.53
	No	120	27		

DISCUSSION

According to the prevalence range classification by World Health Organization, the prevalence for wasted and underweight reported are low while the prevalence of stunting is in the medium category. [14] This however should not trigger complacency to action, since the findings do not generalize the situation for the entire region.

The prevalence of child under-nutrition reported; wasting, stunting and underweight in the area were lower when compared with the national prevalence reported in the latest national demographic health survey; 4% wasting, 26% stunting and 11% underweight.[5]

In comparison to the larger Siaya County, The proportions for stunting and underweight in Asembo, found by the study, were much lower than those reported for Siaya County in 2014 at 25% and 7.8% respectively. [5]

The findings of this study show that the levels of under nutrition may have decreased in Asembo over the years, going by proportions of stunting (33%) and wasting (7%) reported in 2011 in a paper looking at the burden of common infectious disease syndromes in Asembo. [15] The variance however, may be due to the fact that Feikin's paper included children from 6 months, while this study looked at children from 36-60 months only.
Asembo is an area covered by the Household Demographics surveillance and survey project, led by Kenya Medical Research Institute in collaboration with Centers for Disease Control of the United States of America. The project closely monitors infectious diseases and quickly refers children and adults for treatment. The project also offers free medical care for its participants in one of the health facilities in the area. The area was also the site that was first used for trials before the introduction of the Rotavirus vaccination. Due to these interventions and increased emphasis on seeking care has led to decreased morbidities and mortalities in the area. [16] Reduced morbidities due to infectious diseases and more so declines in diarrheal diseases may be some of the reasons why the prevalence of under-nutrition seem to have declined in Asembo.

A comparison between the prevalence of under- nutrition reported by the study and those reported by a study conducted in a neighboring county in Western Province, shows that the prevalence of the study area were low, given prevalence of under-nutrition found by the study in Western province were 28.9% stunting, 1.7% wasting and 6.6% under weight.[17] The two studies however concur, in that the levels of wasting in these two close regions were lower than the other under-nutrition indicators.

In a study conducted in Machakos County in Kenya, the prevalence of under-nutrition reported were higher than those that were found in Asembo. The Machakos study reported wasting at 6%, stunting at 38% and underweight at 21%. [29] The similarity between these two studies is that both were school based but the Machakos study targeted children from the age of 2 to 5 years.

Diarrheal episode in the 2 weeks prior to interview was found to be significantly associated with wasting. This finding is concurrent with the findings of a systematic review paper, looking at stunting, wasting and underweight in Sub-Saharan Africa, whereby different papers from Nigeria, Somalia, Ethiopia, Uganda and Kenya, reported diarrheal episode as a risk factor for wasting. [18] Poor appetite, vomiting, deliberate withholding of food resulting in poor intake, malabsorption of macro and micronutrients; hastening of intestinal transit time; disturbance of metabolic and endocrine function; and direct loss of proteins and other nutrients in gastrointestinal tract are some of the known mechanisms which have an impact on nutrition during an episode of diarrhea.[19]
A study conducted in Ethiopia also reported that children with history of diarrheal morbidity in the previous 2 weeks preceding the date survey had higher odds of developing wasting. Delayed

treatment and poor health seeking behaviour and inappropriate home based management of diarrhea may increase the vulnerability of child developing wasting. [20]

This study found that children with stunting were more likely to come from poorer homes than those who came from richer homes as indicated by the wealth quintiles. Studies in Nepal, Bangladesh and Kenya show that children in higher wealth indices are less likely to be stunted than those in lower wealth indices.[21] [22] [23]. The study confirms that poverty is associated with malnutrition in most developing countries.

The study showed that diarrhea was associated with underweight. Children who were underweight were more likely to have had diarrhea in the last two weeks prior to interview than those who were not underweight. This finding contradicts a study conducted in Rwanda, which did not find diarrhea morbidity in the last two weeks as a risk factor for being underweight. [24] In a study conducted in Ethiopia however, diarrhea in the last 2 weeks prior to the interview was found to be associated with being underweight, whereby children who had had diarrhea were more likely to be underweight than those who had not. [25]

This study showed that nutritional status is a predictor of psycho-social and academic performance in pre-school children in the comprehension and school attendance domains respectively. The findings contradict findings from a school based study targeting 3-5 year old children in Indonesia, which found significant associations between stunting and underweight with cognitive development but no significant relationship was observed between wasted and cognitive development. [26]

In a paper looking at determinants of cognitive function in childhood, it was reported that cognitive function was negatively associated with stunting. [27] The findings of this study established negative associations between stunting and interaction of children with other children however, the association was not significant.

In a study conducted in Nigeria on the relationship between child development and nutritional status of under-five Nigerian children, there was no significant association observed between any of the nutritional status parameters and cognitive and language skills tested.[28] The findings of the Nigerian study are in line with the findings of this study as there was no significant association observed between stunting and underweight and the parameters of psychosocial and academic performance used.

CONCLUSIONS

The prevalence of under-nutrition in pre-school children in Asembo area is low. However, breaking down the proportions by age group and gender reveals substantially higher prevalence of under-nutrition in the different children categories.

Child morbidity; particularly diarrhea in the last two weeks prior to the survey and poverty were established as factors associated with under- nutrition. The study did not establish any association between under-nutrition and school water and sanitation characteristics.

The study established a significant association between under-nutrition (wasted) and comprehension of the children and absenteeism from school.

RECOMMENDATIONS

Recommendation is made for studies seeking to establish the prevalence of under-nutrition in pre-school children and the associated factors to be conducted in Siaya County and the region in general, so as to allow for generalization of results.

It is recommended that more studies looking at association between under-nutrition and psychosocial and academic performance be conducted in the country. This will allow for confirmation of the association since there is very limited data of such studies in the country.

It is further recommended that a study using different methodology to obtain the psychosocial scores of the children rather than use the opinion of the teachers, be conducted so as to avoid bias.

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AUTHORS

First author- Terry Watiri Komo, School of Public Health, Jomo Kenyatta University of Agriculture and Technology, Email: terrywatiri@yahoo.com

Second author- Dr. Daniel Mokaya, School of Public Health, Jomo Kenyatta University of Agriculture and Technology, Email: dmokaya@jkuat.ac.ke

Third author-Ms. Caroline Musita, School of Public Health, Jomo Kenyatta University of Agriculture and Technology, Email: cmusita@jkuat.ac.ke

Correspondence author-Terry Watiri Komo, Email: terrywatiri@yahoo.com, alternate Email: tkomo@kemricdc.org, contact telephone number: 0710261810