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Ruth N. Mutua, Joseph Keriko, Joseph Mutai

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[1*]Ruth N. Mutua
Post Graduate Student, Jomo Kenyatta University of Agriculture and Technology
*Corresponding Author's Email: rmutua2007@yahoo.co.uk

[1]Joseph Keriko
Jomo Kenyatta University of Agriculture and Technology
[2]Joseph Mutai
Kenya Medical Research Institute
Corresponding Email: joemutai@yahoo.com

Abstract

Purpose: The main objective of this study was to determine factors associated with stunting, wasting and underweight among children aged 2-5 years in early childhood development and education centers in Masinga sub county, Machakos County.

Methodology: This was a descriptive cross sectional study. This study was conducted amongst 322 children in 15 randomly selected public early childhood development and education centers. Simple random sampling was used to select the children. Data was collected from mothers of children aged 24 to 59 months using pre-tested structured questionnaires and was analyzed using Statistical Package for Social Sciences, version 10. Chis-square was used to measure the relationship between variables at $p \leq 0.05$. Data was then presented in frequencies, percentages, graphs and tables.

Results: Factors such as socio-economic characteristics, environmental and health characteristics of children, among others, were found to be having some form of associations with stunting, wasting and underweight. The following variables had significant relationship; mother's religion with wasting p= 0.111, age of the child with stunting p= 0.033 and underweight p= 0.038, level of the ECDE with stunting p= 0.034 and underweight p= 0.038, sex of the child with stunting p= 0.021, underweight p= 0.032 and wasting p= 0.012 and availability of the toilet with underweight p= 0.024.

Unique contribution to theory, practice and policy: Stunting, wasting and underweight among children aged 2-5 years continue to be a major public health concern that needs concerted efforts from a multi-sectoral approach to at least reduce the impact associated with the same. Factors such as age of the child, level of the ECDE, sex and environment, among others, are some of the main contributors to stunting, wasting and underweight among children. There is need for Machakos County government to implement a county nutrition integrated program with a community-based nutrition component that is linked to education, health, water and sanitation, and other relevant partners.

Key words: *stunting, wasting, underweight, early childhood development, education centers*

1.0 INTRODUCTION

1.1 Background of the Study

Adequate nutrition is essential in early childhood to ensure healthy growth, proper organ formation/function, strong immune system, and neurological/cognitive development. Under-nutrition among the under-five is a major public health problem in both developed and developing countries Kenya included. Globally, 26%, 16% and 8% of children aged below five were stunted, underweight and wasted respectively in 2011 with Sub-Saharan Africa contributing 40%, 26% and 10% of the above prevalence respectively (Elham *et al*., 2014; UNICEF *et al*.,2013).

In 2014, approximately 26 %, 4 % and 11 % of the under-fives were stunted, wasted and underweight respectively in Kenya. Machakos County where Masinga Sub County is located, 27 % of children were stunted, 7% underweight and 8 % wasted (KDHS, 2014). Pre-school children in sub Saharan Africa have been shown to bare the most burdens where by contributing 35.8% are underweight, 42.7% stunted and 9.2% wasted (Patrice *et al.*, 2007).

A child whose height-for-age is less than -2 SD is considered stunted. Stunting refers to shortness and indicates long-term, cumulative effects of inadequate nutrition and poor health status. Height for age is considered a measure of past nutrition (WHO, 2010). Stunting is the result of failure to receive adequate nutrition over an extended period and may also be affected by recurrent or chronic illness. Stunting is a greater problem than underweight and wasting, it occurs before age two and effects are largely irreversible. These include delayed motor development, impaired cognitive function and poor school performance (Onis and Blössner, 2000).

Wasting is a condition measured by weight for height and results from loss of both body tissue and fat in a body. It is the result of a weight falling significantly below the weight expected of a child of the same length or height. A child whose weight-for-height is less than -2 SD is deemed wasted. Wasting is indicators of current or acute malnutrition resulting from failure to gain weight (Cogill, 2003).

Although large nutritional national studies have been conducted among Kenyan children (KDHS, 2008 – 2009), there is paucity of data concerning the level of stunting, wasting and underweight and its associated factors among children in early child hood education. A better understanding of the context of this could help to develop effective interventions to improve nutritional status during this important stage in life.

2.0 MATERIALS AND METHODS

This was a descriptive cross sectional study. Data was collected from mothers of randomly selected children aged 24 to 59 months attending early childhood development and education, using pre-tested structured questionnaires. Data entry and cleaning was done using MS Access then analyzed using Statistical Package for Social Sciences and presented by frequencies, percentages, graphs and tables. Chi square test was used to explore statistical significance wherever appropriate. The significance level was at $P< 0.05$ in all statistical tests.

Ethical approval was sought from the Kenyatta National Hospital / University of Nairobi Ethical Review Committee before the commencement of field work. Mothers of the children were requested to go to the education centers through invitation letters taken by their children

so that they can give their consent and participate in the study. Mothers were assured of confidentiality in all the processes associated with the study.

3.0 RESULTS

This study recruited a total of 322 respondents out of which 59.3%, 81.3%, 49.1%, 87.9%, 41% and 41.6% were aged 20 to 24 years, married, had primary, were Christian, had no income and were un employed (table 1).

Table 1: Socio demographic and economic characteristics

Characteristics	**N= 322**	
Social demographic and economic	**n**	
		%
Distribution of respondent by age		
20 -24	39	1.2
25 – 29	191	59.3
30 – 34	45	13.9
35 – 39	47	14.5
Marital status		
Married	262	81.3
Single	20	6.2
Separated/widowed	40	12.4
Mothers Education level		
Primary	158	49.1
Secondary	157	48.7
Tertiary	7	2.2
Mother's religion		
Christian	283	87.9
Muslim/Other religion	39	12.1
Level of income		

<1US $per day	102	31.6
1 and >1 US $ per day	88	27.3
No income	132	41.0
Source of income		
Casual	11	3.4
Farming	125	38.8
Formal employment	3	0.9
Self-employment	49	15.2
Unemployment/housewife	134	41.6

Most (49.1%, 51.2% and 49.1%) of the children were aged from 48 to 59 months, boys and at preprimary level of the ECDE respectively, while 20.2%, 48.4% and 20.2% were aged 24 to 35 months, girls and at baby class as shown in table 2.

Table 2: Children's characteristics

Characteristics		
Social demographic and economic	**N=322**	
	N	**%**
Age group of the child		
24- 35	65	20.2
36 – 47	99	30.7
48- 59	158	49.1
Sex of the child		
Boys	166	51.2
Girls	156	48.4
Child's level of ECDE		
Baby class	65	20.2
Play group	99	30.7
Pre-primary	158	49.1

Most (72%) of the respondents reported that their source of food was from own farms, while 23% purchased and 5% got from relatives (table 3).

Table 3: Household food security characteristics

Characteristics		
Household Food Security &Environment/Hygiene	**N=322**	
	N	**%**
Sources of family food		
Own farm	232	72.0
Purchased	74	23
Relatives/friends/government	16	5

Majority (96.9%) of the respondents had not breastfed their children up to 24 months. About 66.1% of the children were being fed from family pot, 74.2% had three meals per day, 65% were not having snack in between the meals, 44.4% consumed *muthokoi/iryo*, (a mixture of beans and crushed maize) as their main food and 57.8% had no animal products in their diet (table 4).

Table 4: Feeding practices characteristics

Characteristics		
Feeding Practices	N=322	
	N	%
Breast fed up to 24 months		
Yes	10	3.1
No	312	96.9
Currently feeding from family pot		
Yes	213	66.1
No	109	33.9
Number of meals take per day		
1meal	6	1.9
2meals	21	6.5
3meals	239	74.2

More than 3 meals	56	17.4
Snack between meals		
Cassava	20	6.2
Eggs	29	9
Fruits	21	6.5
Porridge	42	13
None	210	65.2
Main food consumed in the family		
Muthokoi/Iryo	143	44.4
Rice	47	14.6
Ugali	54	16.3
Uji	45	13.9
Vegetables	23	7.1
Animal products for house hold food		
Eggs	36	11.2
Ghee	3	0.9
Meat	56	17.4
Milk	41	12.7
None	186	57.8

Most (70.8%) of the respondents rarely washed their hands before preparation of the food, only 41.6% got their drinking water from a tap. Majority (87%) were not treating the water and 38.5% had no toilet.

Table 5: Environment Characteristics

Characteristics	**N=322**	
Environment/Hygiene	**N**	**%**
Wash hands before food preparation		
Always	71	22.0

Often	23	7.1
Rarely	228	70.8
Source of drinking water		
Shallow well	52	16.1
Water tap	128	39.8
River	34	10.6
Stagnant water on road side/field	3	0.9
Underground water	97	30.1
Others	8	2.5
Treatment of household water		
Treat	42	13.0
Do not treat	280	87
Toilet availability		
Toilet available	198	61.5
No toilet	124	38.5

Nearly all (99.1%) the children were reported not to have been dewormed, 87.6% had been sick from fever/malaria in the past 6 months, 58.1% had not received nutritional supplementation where majority (81.4%) got from government health facility, most (56.8%) of the mothers had not received nutritional information as shown in table 6.

Table 6: Health care characteristics

Characteristics	**N=322**	
Health care and diseases	**N**	**%**
Dewormed		
Yes	3	0.9
No	319	99.1
Had been sick in the past 6months		
Yes	282	87.6
No	40	12.4
Diagnosed disease		
Cough/RTI	19	5.9
Diarrhea	12	3.7
Fever/Malaria	288	89.4
Chicken pox	1	0.3
Septic rash	1	0.3
Other	1	0.3
Reception of the nutritional information		
Yes	139	43.2
No	183	56.8
Child's supplementation and under nutrition		
Yes	135	41.9
No	187	58.1
Source of supplements and under nutrition		

CHW	37	11.5
GHF	262	81.4
PHF	23	7.1

Of the 322 children assessed 38%, 21% and 6% of the children were stunted, underweight and wasted, respectively as shown in figure 1.

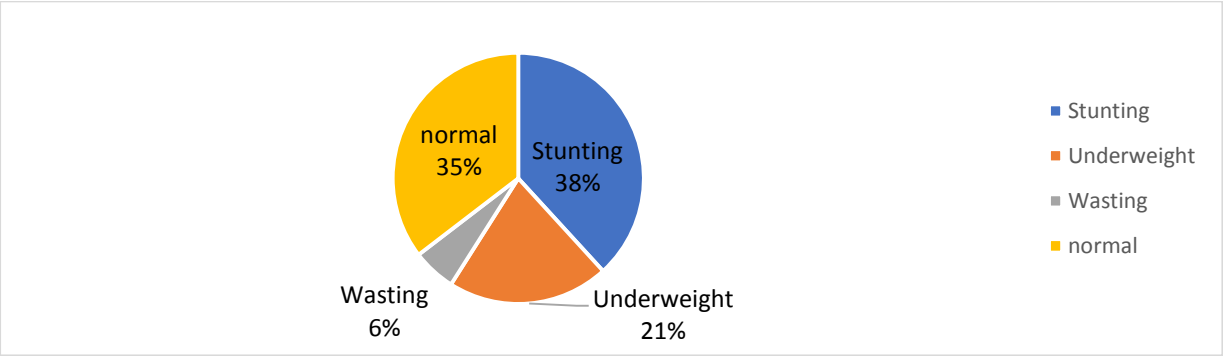

Figure 1: Level of stunting, wasting and underweight in percentage

Chi square analysis performed to determine if stunting, underweight and wasting was associated with social economic /demographic, child's characteristics, feeding practices, environment and health showed that mothers age had no significant association with child's stunting, underweight and wasting p=0.236, 0.236 and 0.305 respectively. Mother's marital status also had no significant relationship with child's stunting p= 0.489, underweight p= 0.859 and wasting p=0.386.

Mother's level of education had no significant relationship with child's stunting p=0.159 or wasting p=0.859. There was no significant relationship between mother's religion and child's stunting p= 0.584, underweight p= 0.366 and wasting p= 0.111. The level of mother's income had no significant association with stunting p= 0.905, underweight p= 0.513 and wasting p= 0.679.

Mother's employment had no association with child's stunting p= 0.554, underweight p=0.554 and wasting p= 0.881 (table 7).

Table 7: Maternal social demographic and economic factors by stunting, underweight and wasting

Characteristic	**Stunting**		**Underweight**		**Wasting**	
	38.2(123)		**20.8(67)**		**5.6(18)**	
Social demographic and economic		**P value**		**P value**		**Pvalue**
	%		**%**		**%**	
Distribution of respondent by age						
20 -24	40.8	0.236	21.3	0.236	6.1	0.305

25 – 29	32.5		20.4		4.7	
30 – 34	44.4		15.6		2.2	
35 – 39	44.7		22.5		10.6	
Total	**38.2(123**		**20.8(67)**		**5.6(18)**	
Marital status						
Married	36.8	0.489	20.6	0.859	5.9	0.386
Single	25.0		15		0	
Separated/widowed	36		20		5	
Total	**38.2(123**		**20.8(67)**		**5.6(18)**	
Mothers Education level						
Primary	36.9	0.159	16.1	0.078	4.2	0.430
Secondary	35.7		23.6		7.0	
Tertiary	71.4		42.9		0	
Total	**38.2(123**		**20.8(67)**		**5.6(18)**	
Mother's religion						
Christian	36.5	0.584	19.5	**0.366**	6.1	0.111
Muslim/Other religion	41.0		25.6		0	
Total	**38.2(123**		**20.8(67)**		**5.6(18)**	
Level of income						
<1US $per day	35.3	0.905	20.6	0.513	5.9	0.679
1 and >1 US $ per day	37.5		23.9		6.8	
No income	38.0		17.6		4.2	
Total	**38.2(123)**		**20.8(67)**		**5.6(18)**	
Employment						
Casual	18.2	0.554	9.1	0.554	9.1	0.881
Farming	37.6		20.3		6.4	
Formal employment	66.7		33.3		0	
Self-employment	34.7		22.5		6.1	
Unemployment/housewife	38.2		17.4		4.2	

Child's age had significant relationship with stunting p= 0.033 and underweight p= 0.038 but not with wasting p= 0. 340. Children aged from 48 to 59 months were more likely to be stunted (41.1%) and underweight (64.2%) compared those aged 24 – 35 months (39.4% and 23.9%). There was significant relation between sex of the child and stunting p= 0.021, underweight p= 0.032 and wasting p= 0.012. Boys were more likely to be stunted (40.3%), underweight (21.6%) and wasted (6.3%) as compared to girls (33.3%, 18.6% and 4.5%).

Child's level of ECDE was also found to be significantly associated with stunting p= 0.034 and underweight p=0.038 but not with wasting p= 0.340. Children in preprimary level of the early childhood development and education centers (ECDE) were more likely to be stunted (40.5%) and underweight (25.6%) compared to those at baby class (23.1% and 12.3%) as shown in table 8.

Table 8: Children's characteristics by stunting, underweight and wasting

Characteristics	**N=322**	**Stunted**		**Under weight**		**Wasting**	
Social demographic and economic	**N**	**%**	**P value**	**%**	**P value**	**%**	**P value**
Age group of the child							
24- 35	65	21.3	0.033	11.9	0.038	4.6	0.340
36 – 47	99	39.4		23.9		3	
48- 59	158	41.1		64.2		7.1	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Sex of the child							
Boys	166	40.3	0.021	21.6	0.032	6.3	0.012
Girls	156	33.3		18.6		4.5	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Child's level of ECDE							
Baby class	65	23.1		12.3		4.6	
Play group	99	40.4	0.034	16.2	0.038	3.0	0.340
Preprimary	158	40.5		25.6		7.1	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	

Source of family's food had no significant relationship with child's stunting p= 0.717, underweight p= 0.482 and wasting p= 0.184 (table 9).

Table 9: Household food security by stunting, underweight and wasting

Characteristics	N=322	Stunting		underweight		wasting	
	n(%)	%	P value	%	P value	%	Pvalue
Household Food Security &Environment/Hygiene							
Sources of family food							
Own farm	232	36.4	0.717	19.4	0.482	4.1	0.184
Purchased	74	40.5		24.3		8.1	
Relatives/friends/government	16	31.3		12.5		12.5	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	

Duration of breast feeding had no significant relationship with stunting p= 0.672, underweight p= 0.771 and wasting p=0.734. Feeding the children from family's pot had no significant association with stunting p= 0.493, underweight p= 0.257 and wasting p=0.680. Number of meals taken by child per day was also not significantly associated with stunting p= 0.070, underweight p= 0.697 and wasting p=0.440. Snacking between meals showed no significant association with stunting p= 0.254, underweight p= 0.782 and wasting p=0.210. Main food consumed in the family was not significantly related to stunting p= 0.312, underweight p= 0.671 and wasting p= 0.383.

Availability of animal products for food in house hold was not significantly associated with child's stunting p= 0.312, underweight p= 0.671 and wasting p= 0.383 as indicated in table 10.

Table 10: Feeding practices and stunting, underweight and wasting

Characteristics	N=322	Stunting		Underweight		wasting	
Feeding Practices	**n**	**%**	**P value**	**%**	**P value**	**%**	**P value**
Breast fed up to 24 months							
Yes	10	1.6	0.672	20	0.771	0	0.734
No	312	98.4		20.7		5.6	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Currently feeding from family pot							
Yes	213	37.2	0.493	21.1	0.257	4.9	0.680

No	109	36.7		18.3		3.8	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Number of meals take per day							
1meal		16.7	0.070	30.6	0.697	16.8	0.440
2meals	6	52.4		14.3		0	
3meals	21	38.9		21.7		5.6	
More than 3 meals	239	25		16.1		5.3	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Snack between meals							
Cassava	20	35	0.254	30	0.782	15	0.210
Eggs	29	37.9		20.7		3.5	
Fruits	21	52.4		23.8		0	
Porridge	42	23.8		16.7		2.4	
None	210	38.2		19.6		5.9	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Main food consumed in the family							
Muthokoi/Iryo	143	39.3	0.312	20.3	0.671	3.1	0.383
Rice	47	34		21.2		8.5	
Ugali	54	29.6		16.7		5.6	
Uji	45	46.7		26.7		8.9	
Vegetables	23	26.1		13		8.7	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Animal products for house hold food							
Eggs	36	38.9	0.849	30.6	0.130	8.3	0.181
Ghee	3	34.2		66.7		33.3	
Meat	56	35.7		19.6		3.6	
Milk	41	66.7		19.6		2.4	

None	186	37.2	17.9	5.6
Total		**38.2(123**	**20.8(67)**	**5.6(18)**

Washing of hands by mothers before food preparation had no significant relationship with child's stunting p= 0.691, underweight p= 0.064 and wasting p=0.077. There was no significant relation between source of water and child's stunting p= 0.089, underweight p= 0.452 and wasting p=0.694. House hold water treatment was not significantly associated with child's stunting p= 0.067, underweight p=0.602 and wasting p=0.967.

Availability of toilet had significant association with child's underweight p=0.024, but not with child's stunting p= 0.058 and wasting p=0.522. Children whose mother had availability of toilet were less likely to be underweight (16.4%) compared to those of mothers with no toilet 26.6% see table 11

Table 11: Environment by stunting, underweight and wasting

Characteristics	**N=322**	**Stunted**		**Underweight**		**Wasted**	
		%	**P value**	**%**	**P value**	**%**	**Pvalue**
Environment/Hygiene							
Wash hands before food preparation							
Always	71	33.8	0.691	25.4	0.064	8.5	0.077
Often	23	43.5		34.8		13	
Rarely	228	37.4		17.2		3.8	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Source of drinking water							
Shallow well	52	50.0	0.089	25	0.452	5.8	0.694
Water tap	128	36.2		21		3.6	
River	34	20.6		11.8		5.9	
Stagnant water on road side/field	3	0		0		0	
Underground water	97	38.1		18.6		8.3	
Others	8	37.5		35.5		0	

Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Treatment of household water							
Treat	42	33.3	0.067	16.7	0.602	10.2	0.967
Do not treat	280	37.6		20.7		5.5	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Toilet availability							
Toilet available	198	33.2	0.058	16.4	0.024	4.8	0.522
No toilet	124	43.6		26.6			6.5
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	

Deworming of the children was not significantly associated with stunting p= 0.275, underweight p= 0.475 and wasting p=0.734. Child's sickness in the past six months had no significant association with stunting p= 0.775, underweight p= 0.384 and wasting p=0.106. There was no significant relation between mothers receiving nutrition information and stunting p= 0.758, underweight p= 0.492 and wasting p=0. 141. Child's supplementation was also noted not to have significant association with stunting p= 0.264, underweight p= 0.532 and wasting p=0.875. There was no significant relation between source supplementation and child's stunting p= 0.615, underweight p= 0.283 and wasting p=0.204 (table 12).

Table 12: Health care by stunting, underweight and wasting

Characteristics	**N=322**	**Stunted**		**underweight**		**Wasting**	
		%	**P value**	**%**	**P value**	**%**	**P value**
Health care							
Dewormed	**N**						
Yes	3	0	0.275	0	0.475	0	0.734
No	319	37.1		20.4		5.5	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Had been sick in the past 6months							
Yes	282	37.3	0.775	20.9	0.384	6.2	0.106
No	40	35		15		0	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	

Diagnosed disease							
Cough/RTI	19	31.6	0.543	21.1	0.551	0	0.818
Diarrhea	12	25		0		0	
Fever/Malaria	288	38.4		21.2		6.2	
Chicken pox	1	0		0		0	
Septic rash	1	0		0		0	
Other	1	100		0		0	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Reception of the nutritional information							
Yes	139	35.7	0.758	28.6	0.492	14.3	0.141
No	183	39.9		20.8		4.9	
Child's supplementation and under nutrition							
Yes	135	33.3	0.246	18.5	0.532	5.2	0.875
No	187	39.6		21.3		5.6	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	
Source of supplements and under nutrition							
CHW	37	29.7	0.615	13.5	0.283	2.7	0.204
GHF	262	37.9		20.2		5.2	
PHF	23	39.1		30.4		13.0	
Total		**38.2(123**		**20.8(67)**		**5.6(18)**	

4.0 DISCUSSION

Stunting, wasting and underweight among children have continued to be areas of public health concern to many developing countries including Kenya. This study found that 38.2%, 20.8% and 5.6% of the children were stunted, underweight and wasted, respectively. These levels supersede national (26%, 4% and 11%), sub Saharan Africa (35.8%, 9.2% and 42.7%) and global stunting of 26% and underweight of 16% (KDHS, 2014; Patrice *et al.*, 2007).

Children of mothers involved in this study were at their vulnerable age period when rapid growth and development is taking place. Hence, they are predisposed to a greater risk of dying from severe infections, poor growth and development, impaired cognitive ability and reduced school and work performance in future. This will finally contribute to lack of

development in this particular community and hence the entire nation. The finding in this study is similar to those of other studies. Sourabh *et al*., (2015) in his study in India found out 35.5%, stunted and 19.7%, underweight.

Due to limited agricultural production diversification of food is not commonly practiced majority of the household are forced to feed on diet comprised of plant based foods, mainly cereals and non-cereal based foods which included *muthokoi/isyo* (mixture of either crushed or non-crushed maize and beans or peas), rice, *ugali, uji* with little vegetables and animal produce consumption. Total protein in plant-based foods has been proven to be lower than in animal sources. Plant protein is also less digestible and deficient in one or more essential amino acids compared to animal protein (Adler and Specker, 2001). These children are also not optimally fed since they only feed three meals per day without a snack contributing to under feeding.

Frequent low rainfall with drought in the area leads to scarcity in clean water. This contributes to poor hygiene and sanitation practices. Only 39.8% of the household had access to piped water, 12.6% treated their drinking water and 21.4% washed their hands before feeding their children. Majority of the ECDE centers in the area are also not connected with piped clean water for drinking, cleaning of utensils and food before cooking and hand washing by children, before and after eating. Water used in most of these centers is mainly fetched from nearby water boreholes using either donkeys or oxen pulled cats which has high chances of being contaminated. Improved water, sanitation and hygiene has been shown as a part of promoting healthy environments and hence reduction of infectious diseases that can lead to undernutrition (Guerrant, 2008).

A mother is the principle provider of the primary care that her child needs during the first five years of life. Hence, lack of nutritional awareness among mothers in this study whereby only 55.1% had received nutritional training implies inadequate knowledge and skills on nutrition and this impart negatively on the health of children (Salehi *et al.*, 2004). The study also found that 89.6% of the children had been sick mainly suffering from cough, diarrhoea, malaria within the first 6 months of the study, such infections can damage a child's digestive system to the extent where even a nutritious and adequate diet cannot be absorbed into the body, thus posing the risk of undernutrition (UNICEF, 2013).

Despite the consequences associated with worm infestation and benefits of deworming, only 1% of the children in this study had been dewormed, which is very low compared to the global target of 75% (WH0, 2001). Lack of community sensitization to avoid suspicion and misperception since deworming is not a one event but a routine one may have caused decline in uptake due to non-compliance. Lack of financial resource allocation on the program could have also posed threat to the service.

This study found out that age of the mothers had no significant relationship with child's stunting p=0.236, underweight p=0.236, wasting p= 0.305, iodine p=0.159, zinc p= 0.116 and iron (low hb) p= 0.130. This agrees with Paramita *et al.,* (2010) who also reported that mother's age was not significantly associated with underweight or wasting. However, it disagrees with other studies that indicated child undernutrition was more prevalent among children born of mothers under the age of 34 years (Ahmed *et al.,* 2015; Das and Hossain, 2008).

The variation in this study could have been brought about due to the current upsurge use of technology among the young mothers that may be changing the trend. Young mothers are

more conversant with internet than the older ones hence use this to learn current ways of feeding their children, this then compensates for their inexperience and lack of authority making their feeding skills just the same as those of the experienced old mothers.

Single motherhood in this study was found not to have any significant relationship with child's stunting p=0.489, underweight p=0.859, wasting p= 0.386, deficient in iodine p= 0.386, zinc p= 0.552. This was supported by other studies conducted in Kenya and Nigeria which found out that, children's likelihood of stunting had no significant association with single motherhood (Adekanmbi *et al.*, 2013; Heaton *et al.*, 2005). The results disagreed with Bronte-Tinkew and DeJong, (2004) who found that the likelihood of stunting among Jamaican children was 4.89 times higher in single-mother households than in two-parent families. Gurmu and Etana (2013) also found that single motherhood nuclear family as a variable significantly increased the likelihood of stunting in Ethiopia although the study did not show whether the single-parent family was single mother or father. In addition, another study has shown that children living in households headed by women are more likely to be undernourished (Fentaw *et al.*, 2013).

The variation of this study with others could have been due to smaller percent (6.2%) of single mothers in this study that could not have made any significant. Economic deprivation in single mother households in this study may also have been weakened by kin support (Gibson and Anderson, 2009; McGadney-Douglass *et al.*, 2005). The effects of single motherhood on child well-being also vary by personal socioeconomic characteristics and type of single motherhood, when single mothers are highly educated and their lone motherhood is deliberate and planned, children are likely to experience no unusual health outcome. Desai (1992) indicated that the relative advantage of children in two-parent families in economic resources is however, dependent on if the parents are gainfully employed, optimally committed to children's well-being, and the commitment is expressed in substantial cash contribution to children's nutrition and health care.

Mother's education level was found not to be significantly associated with child's stunting p= 0.159, underweight p=0.078 and wasting p= 0.430. This disagrees with other researches that shows there is strong linkage between maternal education and children's health. An educated mother is more likely to have a better income base through better employment opportunity and efficient management of income generation activities than an uneducated or less educated one and thus is better able to meet the nutritional needs of her family (Semali *et al.*, 2015). Likewise, an educated mother would have better skills and better information for planning purposes as well as for implementing strategies that can meet adequately the nutritional needs of her children and the whole family (Correia *et al.*, 2014; Ahmed *et al.*, 2015).

Glewwe (1999) highlights three links through which education may affect child health. First, formal education of mothers directly transfers health knowledge to future mothers. Second, the literacy and numeracy skills that women acquire in school enhance their ability to recognise illness and seek treatment for their children. Additionally, they are better able to read medical instructions for treatment of childhood illness and apply the treatment. Third, increased number of years in school makes women more receptive to modern medicine.

Religion of the mother in the current study had no significant relationship with stunting p= 0.584, underweight p= 0.366 and wasting p= 0.111. Dawit *et al.*, (2015) differed with the findings of this current results by showing that there was significant association between stunting and religion. The process of transformation and modernization of food habits and the

cultural and religious value of food has been documented in the literature (Alonso, 2015). The variation of this study is due to the fact that majority (88.3%) of the mothers were Christian, this religion is known to have no food restriction that can interfere with the nutritional status of children.

Mother's level of income also had no significant association with child's stunting p= 0.905, underweight p= 0.513 and wasting p= 0.679 in this study. These results contradicted those from other studies which associated level of income with undernutrition (Chiara *et al.,* 2016; Keino *et al.,* 2014). Elham (2014) showed significant association between stunting and lower family income (OR= 3.21, CI: 1.17–8.85).

The difference between this study's results and others is due to other confounding factors that may be contributing to undernutrition in this study. In an Indonesian study, it was concluded that income in household may be high, but it does not guarantee satisfactory nutritional status of the children in the household, if the quality of diet, healthcare facilities and caring capacity are not adequate (Olatidoye *et al.,* 2011).

Age of the child in this study was significantly associated with stunting p=0.033 and underweight and p= 0.038 in the current study, the older children were more likely to be stunted (41.1%), underweight (64.2%), compared to young children with 23.1%, 11.9%. These results were consistent with those of other studies done in Kartum, Sudan, Nairobi and Congo that indicated that young children had a significantly lower risk of being stunted than children in older age-groups (Ahmed *et al.,* 2011, Gebreegziabiher *et al.,* 2014). Majority of the children in the study area breastfed up to their first year of life. However, beyond 2 years when breastfeeding stops there is no policy or proper guidelines on how to feed the children who are now already in early childhood education and development.

Majority of the children at this age start feeding on family's pot (common family food) where they are exposed to inappropriate feeding (in terms of quantity and quality) and diseases due to poor environmental, water, sanitation and personal hygiene. These children also often receive less attention from parents or caregivers, a behaviour that could affect both the frequency and quality of meals given.

Level of ECDE of the child was found to be significantly associated with stunting p= 0.034 and underweight=0.038, where by children at higher level of the ECDE (Pre-primary) were more likely to be stunted (40.5%) and underweight (25.6%) compared to those at the baby class (40.4% and 16.2%, respectively). The explanation to this phenomenon could be as children move from one level of class to the next level the responsibility of care starts falling more to an individual child because the child grows bigger. This means little attention is given to the feeding and careering of the children who are at higher level by their care givers/mothers and teachers compared to those at lower level. These children in preprimary hence end up getting inappropriate and inadequate food for their age and daily activities. At the same time their immunity gets reduced due poor protection from mother's immunity as compared to the young children hence become more prone to diseases as a result of poor environmental, water, sanitation and personal hygiene (Kanadala *et al.,* 2009).

This study found out that sex was significantly associated with stunting p= 0.021, underweight p=0.032 and wasting p= 0.012, boys were more likely to be stunted (40%), underweight (22%) and wasted (6%) compared to girls (33%, 19% and 5% respectively). The results in this study agreed with those of other studies conducted in Kenya, Ethiopia and Iran which reported that under-five male children were more likely to become stunted than their

female counterparts (Kavosi *et al.,* 2014; Makoka, 2013). Boys have been shown to be more likely to display impact of chronic under nutrition, especially in environments where stresses are at play, like repeated infections and exposure to toxins and air pollutants (Olack *et al.,* 2011).

Despite such benefits, only 3.1% of the children had been breast fed for this duration in this study, this was much lower than 58% globally and 53.6% nationally (KDHS, 2014; UNICEF, 2013). In this study, prolonged breast feeding had no significant relation with child's stunting p= 0.672, underweight p= 0.771 and wasting p=0.734. This agrees with findings by Grummer-Strawn (1993) who report negative association between prolonged breastfeeding and weight-for-age, height-for-age, or weight-for-height. However, it contradicts Simondon *et al.,* (2001) who showed an association between prolonged breast feeding and linear growth.

The negative associations between continued breastfeeding and nutritional status in the current study may have also resulted due to inadequate control of confounding factors such as poverty, lack of health care, inappropriate feeding practices and child morbidity which lead to undernutrition on the one hand, and continued breastfeeding on the other.

Majority (66.1%) of children this study fed from family's pot (common family food) and this was found to have no significant relation with child's stunting p= 0.493, underweight p= 0.257 and wasting p=0.680. Eating adequate food by children is an essential component as they pass through the critical stages of growth and development. Pulling food from a common pot rather than children receiving special individual portions may predispose them to higher risk for undernutrition because the young may not be able to compete for food in this situation. The reason for the insignificant association in this study could have been due to children in this study spending most of their time in school and hence feeding from common pot (family food) occurred only at dinner time and this implies that mothers have less control over the food preparation; the food the child selects and eats.

Optimal feeding depends not only on what is fed but also on how and when the child is fed (Pelto *et al.,* 2003). Although the appropriate number of feedings depends on the energy density of the local foods and the usual amounts consumed at each feeding, there is need to increase the number of times that the child is fed as he/she gets older. For an average child aged 2 to 5 years it is recommended that should be given 3 to 4 meals with 2 snacks in between. This study found out that 74.2% of the children took 3 meals per day with no snack.

Children residing in households without toilet facility have been shown to be 1.5 times more at risk of developing stunting as compared to children in households with toilet facility (Panigrahi and Chandan, 2014). Merchant *et al.,* (2003) showed that children coming from homes with water and sanitation had a 17% greater chance of reversing stunting than those coming from homes without either facility. This could have been due to difference in the level of interaction with the other confounding factors like access to health, number of contacts between the mother and the child among others.

Schistosome and soil-transmitted helminth infections are the most common infectious diseases in developing countries and can impair nutritional status by feeding on host tissues, including blood, which leads to a loss of iron and protein (Crompton and Nesheim, 2002), increased malabsorption of nutrients and loss of appetite and therefore a reduction of nutrition intake and physical fitness (Stephenson *et al.,* 1993). The MOH policy in Kenya demands preschool children to be dewormed once every six months in Kenya (KDHS, 2014).

Regular deworming contributes to good health and nutrition for children of, which in turn leads to increased enrolment in schools and attendance, reduced class repetition, and increased educational attainment (WHO, 2001). However, in this study only 0.9% had been dewormed and there was no significant relationship between child's deworming and child's stunting p= 0.275, wasting p= 0.734 and underweight p= 0.475.

Major illnesses and infections such as diarrhoea and malaria can damage a child's digestive system to the extent where even a nutritious and adequate diet cannot be absorbed into the body, thus posing the risk of undernutrition (UNICEF, 2013). Despite 89.4% of the children suffering from Fever/Malaria for the past 6 months in this study there was no significant relationship between sickness and child's stunting p= 0.775, underweight p= 0.384 and wasting p= 0.106. The current results contradict those of another study (Mandefro, 2015). This could have been probably due to time taken being ill before seeking for medical attention, acute episodes that are cured within shortest time may not go to an extent of interfere ring with the digestive system and hence affect the nutritional status of the child. Effect of morbidity on nutritional status depends upon severity and duration of infection, health care provided and feeding during illness and convalescence (Ramachandran and Gopalan, 2009).

A mother is the principle provider of the primary care that her child needs during the first five years of life. Despite this 56.8% of the mothers had not received training on nutrition in this study and there was no significant relationship between receiving training on nutrition and child's stunting p= 0.758, underweight p= 0.492 and wasting p= 0.141. This agrees with a study conducted on a relationship between Mothers' level of nutritional information and under nutrition which didn't show any significant relationship. Sheikholeslam *et al.,* (2004) concluded that educating mothers about child care, growth and hygiene is made effective through strengthened literacy programme for women that promote home gardening and consumption of healthy foods.

The diets of poor households in developing countries including this study area, are lacking in many of the key vitamins and minerals (micronutrients) which are essential to keep children strong, healthy and productive. Due to lack of income and high poverty people in this study cannot afford dietary diversification including consumption of animal products which are good sources of most bioavailable forms of iron and of absorbable zinc. Nutritional supplements in the form of micronutrient powders or ready-to-use-foods have been shown to provide young children with essential vitamins and minerals (Suchdev *et al.,* 2016). However, in this study only 41.9% had received supplementation and there was no significant relationship between supplementation and child's stunting p= 0.246, underweight p= 0,532 and wasting p= 0.875.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Stunting, wasting and underweight among children aged 2-5 years continue to be a major public health concern that needs concerted efforts from a multi-sectoral perspective. This study has identified some factors such as age of the child, level of the ECDE, sex and environment, among others, as the contributors to stunting, wasting and underweight among children. The semi-arid nature of the study area causes it to experience environmental challenges which include low rainfall and droughts contributing to low agricultural

production since the community depend on rain-fed small holder farming. They are forced to grow mainly drought tolerant crops like *katumani* type of maize, beans, green grams, soghurm and millet, among others.

Due to limited agricultural production diversification of food is not commonly practiced majority of the house hold are forced to feed on diet comprised of plant based foods, mainly cereals and non-cereal based foods with little vegetables and animal produce. Frequent low rainfall with drought in the area also contributes to scarcity in clean water. This contributes to poor hygiene and sanitation practices both in ECDE centers and households.

5.2 Recommendations

Relevant stakeholders including the Ministry of Health and the Machakos county government, together with other partners, should implement a county nutrition integrated program with a community-based nutrition component that is linked with education, health, water and sanitation. In addition, provision of clean water by either drilling boreholes or small dams in the area should be enhanced in order to improve water, sanitation and hygiene among the children and care givers. Improve household access and use of health services will go a long way promoting healthy environments and reduce the prevalence of infectious diseases. The services include immunization, supplementation, deworming.

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