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Malnutrition and its Correlates among Rural Primary School Children of Fogera District, Northwest Ethiopia

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Abstract

Background: Malnutrition is a major public health concern affecting a significant number of school children influencing their health, growth and development, and school academic performance.

Objective: To determine the nutritional status of school children in terms of stunting, underweight and thinness and to identify its correlates at Fogera woreda, Northwest Ethiopia, 2012.

Methods: Institutional and community based cross sectional study was conducted from June to December, 2012. The study included 790 primary school children who were selected from the source population by multi stage random sampling technique. Data were collected through interview with parents with a standardized and pretested questionnaire; microscope, physical examination and anthropometric measuring and data were entered and analyzed using SPSS version 16.0 and AnthroPlus softwares. Binary and Multivariate logistic regression analyses were used to identify factors associated with malnutrition among school children.

Results: Prevalence of malnutrition was high among school children aged six to fourteen years old (mean age 11.4 ± 2.1 years); Study contents include questionnaire surveys, anthropometric measurement, observation and laboratory methods. Finally 790 school-age students took part in study. The results showed that the overall prevalence of stunting, underweight and thinness were 243 (30.7%), 96 (59.7%) and 294 (37.2%). Those children who were found to be both stunted and underweight were only 1.01% (8). Rice consumption, family size, Family radio, infection, vaccination, latrine availability were significantly associated with malnutrition. However, statistically significant association was not found between malnutrition and parasitic infection and other health conditions.

Conclusion: In concluding, the study found high prevalence of malnutrition (stunting, thinness and underweight). Vaccination, family planning, latrine construction and utilization, rice production and prevention and early treatment of infection were identified as essential interventions to reduce the risk of malnutrition. Ownership of radio should be promoted to reduce malnutrition. However, parasitic infection among primary school children was not significantly associated with malnutrition. But, school children should be targeted to deworming to treat parasitic infections.

Keywords: Malnutrition; School children; Fogera; Ethiopia

Background

Globally, malnutrition among school age children is becoming a major public health concern. More than 200 million school age children are stunted and underweight and if no action is taken and at this rate, about one billion school children will be growing up by 2020 with impaired physical and mental development [1-5].

Malnutrition is the underlying cause of one third of the 7.6 million child deaths each year before their fifth birthday. Meeting this challenge is doubly urgent because among children who survive, chronic malnutrition causes devastating and irreversible damage [6]. Lack of nutritious food, coupled with infection and illness, means their bodies and brains don't develop properly and at least 170 million children are affected by stunting [5,7-9].

Conditions of early life (from conception to two years) provide the foundations for adult life. Vicious interactions between malnutrition, poor health, and impaired cognitive development set children on lower development paths and lead to irreversible changes [9].

According to a report made by WFP in 2010, the nutritional status of school-age children impacts their health, cognition, and subsequently their educational achievement. The school is an opportune setting to provide health and nutrition services to disadvantaged children [10-14]. Yet, school-age children are not commonly included in health and nutrition surveys and an up-to-date overview of their nutritional status across the world is not available [2,15-19]. Despite emergence of a number of advancements in areas of health and nutrition services in developing countries including Ethiopia, nutritional status of school children is not yet improved and understudied particularly in Fogera district. Therefore, this study was conducted to assess the nutritional status and associated factors among rural primary school children in Fogera district, Ethiopia. These results could be used to design and develop measures targeting school children to improve their nutritional status.

Methods

Design, setting and sampling

This was both an institution (school) and community based cross-sectional study conducted among primary school children aged 6-14 years at Fogera district, Northwest Ethiopia from July to December, 2012.

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A multistage random sampling technique was used to select 790 children aged 6-14 years in four full cycle primary schools of the district. The district has 42 full cycle primary schools and two secondary schools.

Data collection

Questionnaire survey: First, school children were screened at school to participate in the study and then parents were traced back for detaile information (interview) on personal (student), and parental socio-economic, demographic, environmental and access to facilities and health and health related issues at the community level. Data on the type of most frequently produced ad consumed crop, house hold assets and other aspects were collected during interview by five health extension workers (Rural community health workers). After completion of questionnaire survey, two nurses did anthropometric measurement and physical examination for any health related conditions like presence of conjunctivitis, oedema, and distended stomach, other gross abnormalities, shoes wearing and personal hygiene conditions. Senior laboratory technologist did laboratory investigation for schistsomia and helminthic infections at school for 790 primary school children.

Anthropometric measurement: Body weight and height were measured using the standardized procedures. Weights of the students were recorded using a scale to the nearest 0.1 kilograms (kg). Heights were measured to 0.1 centimeters (cm). Students wore light cloths and no shoes during measurement. Weighing scale was calibrated to the zero before taking every measurement.

School children with Z-score values of < -2SD for height for age were classified as stunted and those who were < -3SD were termed as severely stunted. Likewise, children with Z-score value of < -2SD and < -3 SD for weight for height were classified as thin and severely thin or low BMI for age. Children with Z-score value of < -2 SD and < -3 SD for weight for age were also classified as underweight and severely underweight respectively. This was done as per the WHO criteria and classification standard.

Physical observation: Observation on personal hygiene, dirt particles in fingernails, shoes wearing, Oedema, distended stomach and other abnormalities was made by two trained nurses.

Laboratory investigation: Stool samples were examined by the Kato-Katz technique (thick smear 41.7 mg). Containers with applicative stick for collection of stools were dispensed to sampled students after labeling separately and they were asked to collect and deliver samples of their faeces.

Data management and analysis

Quality control measures and good practices including, training of data collectors, pre-testing of processes and materials and field monitoring of data collection were made before and during data collection process.

Anthropometric indices were calculated using the new World Health Organization Child Growth Standards, WHO, 2007AnthroPlus software [20].

STH infections were expressed as the number of eggs per gram stool (EPG) using Kato katz kits [21].

Statistical analysis: Statistical analysis of the data was performed using the statistical package for Social Sciences for Windows SPSS (version 16.0). Z-score for stunting, underweight and low BMI for age were calculated by WHO, 2007 AnthroPlus software [20].

This software is for the global application of the WHO reference for 5-19 years to monitor the growth of school-age children and adolescents. The software does not calculate underweight for children aged 10 and above years. This is because of the assumption that children 10 years and above start to show secondary sexual characteristics (puberty) and as age increases, weight also increases and it is not fair to take underweight as good nutritional indicator for children aged 10 years and above. Bivariate and Multivariate logistic regression analyses were used. Hosmer and Lemshow goodness of fit test was made.

For final model multivariate logistic regression model was used as the outcome variable is dichotomous and social relationships and phenomena are usually more complex than is allowed for in a bivariate analysis. Multivariate analysis is thus commonly used as a reflection of this complexity. This judgment was made after taking a look at the AnthroPlus software analysis for malnutrition among all children and they all were found to be either malnourished (stunted, underweight and low BMI for age) or normal; no one was overweight or obese. So, it is dichotomous, malnourished: normal. But if school children were found to be overweight or obese, the analysis could be multinomial logistic regression. That is the justification for us to use multivariate logistic regression.

Eventually, variables with significant association at 0.2 and less level of significance were entered to final model and identified on the basis of p-value at 0.05 with 95% CI. Because those variables which might not be strong enough to show significant association might have significant association when coupled with other variables in the final model. Forward LR was used as method of analysis.

Results

Demographic characteristics of the students

A total of 790 school children from four full primary schools took part in the study (participation rate=90%). Girls were 374 (47.3%). The average age of school children was 11.4 years (SD=2.1) and the average size of the family was 6.3 (SD ±1.5) (Table 1).

The average ages of mothers and fathers were 36.6 and 44.4 with standard deviations of ± 6.4 and ± 8.6 respectively. Majority of them (94%) were married and 97.9% were farmers. Mothers with primary education were only about 13.6% and 38.5% for fathers. Orthodox Tewahido Christianity was the most frequently appeared parental religion (73.5%), followed by Islam (14.4%) and others were 12% who are members of Awuramba community which do not have any religion.

Nutritional status of school children

The prevalence of stunting was 30.7% of this 0.6% of the students was severely stunted. Underweight prevalence among children aged 5-9 was 59.7% and from this 7.5% were found to be severely underweight. Those with low BMI for age (thin) were 37.2% of the total population; of these 6.5% had severe low BMI for age. Only 1.01% (8) was found to be both stunted and underweight (Table 2).

High prevalence of stunting was found at the late ages of school children, at 14 (59%) followed by 49% at the age of 13.

The prevalences of stunting and thinness (low BMI for age) among males were 29.4% and 42.6% respectively and underweight for children from 5-9 years of age was 75.6%.

Stunting prevalence among females was 32.2% and thinness was 31.2%. Underweight for children aged 5-9 was 42.9%.

Variable	Category	n (%)
Age of mother	22-35	385 (48.7)
	36-45	336 (42.5)
	>45	67 (8.5)
Age of Father	24-35	86 (10.9)
	36-45	422 (53.4)
	>45	67 (8.5)
Marital status of mothers	Married	740 (93.7)
	Divorced	29 (3.7)
	Widowed	19 (2.4)
Age of school children	5-9	156 (19.7)
	10-14	634 (80.3)
Sex of school children	Male	416 (52.7)
	Female	374 (47.3)
Religion of parents	Orthodox Christian	582 (73.7)
	Muslim	114 (14.4)
	Others	94 (11.9)
Mothers' education	Does not read/write	681 (86.2)
	Primary education	107 (13.5)
Fathers education	Does not read/write	453 (57.3)
	Primary education	287 (36.3)
	Secondary and above	6 (0.8)
Occupation of fathers	Farmer	731 (92.5)
	Merchant	10 (1.3)
	Government employee	5 (0.6)
Family income	150-1000	627 (79.4)
	1001-2000	85 (10.8)
	>2000	78 (9.9)
Family size	2-5	224 (28.4)
	6-8	511 (64.7)
	>8	55 (7.0)
Ownership of radio	Yes	248 (31.4)
	No	542 (68.6)
Family decision maker	Father	173 (21.9)
	Mother	47 (5.9)
	Both by discussion	570 (72.2)
Ownership of livestock	Yes	785 (99.4)
	No	5 (0.6)
Most type of crop	Rice	329 (41.6)
	Others	461 (58.4)

Table 1: Socio-economic and demographic characteristics of parents and full cycle primary school children at Fogera district, Northwest Ethiopia, September to October, 2012.

Variable	Light to moderate n (%)	Severe n (%)	Total
Stunting	238 (30.1)	5 (0.6)	243 (30.7)
Underweight (5-9)	84 (51.9)	12 (7.5)	96 (59.4)
Thinness	242 (30.6)	52 (6.5)	294 (37.1)

Table 2: Prevalence of malnutrition among school children in Fogera district Northwest Ethiopia, September to October, 2012.

Housing and environmental health factors

Those households who had latrine were 46.7%. The source of drinking water for 44.7% of household was found to be protected spring and wells and the sources for rest 55.3% were rivers and unprotected water sources (Table 3).

Health and health related factors

Of all the study participants, 377 (47.7%) were found to be vaccinated, but only 24 (3%) were fed breast milk only up to six months. Participants who had any kind infection/morbidity two weeks before the data collection were 27 (3.4%) (Table 4).

Prevalence of helminthic and schistosomia infections

The study area is endemic for parasitic infections where school children are at a higher risk. School children who were infected with Schistosomia mansoni infection were 111 (14.1%) while infection prevalence of *Ascaris Lumbricoides*, Hookworm and *Trichuris Trichiura* were 211 (26.7%), 260 (32.9%) and 2 (0.3%) respectively. Infection by other types of parasites (*H. nana, E. Vermiculrais*, and Taenia worm) was 6.3% (Table 5).

Variable	Category	n (%)
Type of roof material	Thatched	59 (7.5)
	Corrugated iron	731 (92.5)
Animals living in the same house	Yes	322 (40.8)
	No	467 (59.1)
Number of rooms of the house	1	86 (10.9)
	2	549 (69.5)
	3	122 (15.4)
	4	32 (4.1)
	5	1 (0.1)
Latrine availability	Yes	369 (46.7)
	No	421 (53.3)
Refuse disposal	Pit	75 (9.5)
	Burning	109 (13.8)
	Open field	511 (64.7)
	Garbage can	95 (12.0)
Source of drinking water	Pipe water	20 (2.5)
	Protected well/spring	333 (42.2)
	Unprotected well/ spring	194 (24.6)
	River	243 (30.8)
Time elapse to fetch water in minutes	5	150 (19)
	10	135 (17.1)
	15	183 (23.2)
	20 and beyond	322 (40.8)

Table 3: Housing and Environmental health factors of parents of school children at Fogera district, Northwest Ethiopia, September to October, 2012.

Variable	Category	n (%)
Infection during previous two weeks	Yes	27 (3.4)
	No	763 (96.6)
Knowledge of mothers on good for children	Yes	676 (85.6)
	No	114 (14.4)
Provision pocket money	Yes	34 (4.3)
	No	756 (95.7)
Immunization status	Yes	377 (47.7)
	No	413 (52.3)
Number of breast milk feeding years	Up to six months	24 (3.0)
	One year	368 (46.6)
	Two years and above	398 (49.6)
Presence of conjunctiva	Yes	0 (0)
	No	790 (100)
Presence of dirt in finger nails	Yes	562 (71.1)
	No	228 (28.9)
Presence of Oedema	Yes	0 (0)
	No	790 (100)
Wearing of shoes	Yes	294 (37.2)
	No	496 (62.8)
Other abnormalities	Yes	0 (0)
	No	790 (100)

Table 4: Health and health related factors of full cycle primary school children at Fogera district Northwest Ethiopia, September to October, 2012.

Malnutrition by specific parasitic infection

From 211 school children infected with Ascaris Lumbricoides, 158 were stunted, 41 underweight, and 138 thin. Of 260 infected with Hookworm, 186 were stunted, 45 underweight and 182 thin. Of 111 school children infected with Schistosomia mansoni, 76 were stunted, 15 were underweight and 80 were thin (Table 6).

Results of multivariate logistic regression analysis for underweight

School children from families with 6-8 members were found to be 2.356 times more likely to be underweight as compared to school children from 2-5 members. This shows family size matters on the nutritional status of school children and it could be because of the resource scarcity. Vaccinated children were less likely to be underweight than unvaccinated school children. In other words, vaccination was found to be protective by 35% from underweight. Moreover, school children who had infection were found to be 4.28 times more likely to be underweight as compared to those who did not have infection/morbidity. Frequent rice production and consumption was found to be protective from underweight and it showed reduction by 89% from underweight. Family radio was found to be again protective by 45% and this could be because of information that could be transmitted on radio (Table 7).

Results of multivariate logistic regression analysis for stunting

Frequent rice consumption again was found to be protective from stunting by 55% (probability to be stunted is 0.45) and school children from families 6-8 members were 1.48 times more likely to be stinted. More number of family sizes could have put children at higher risk for stunting and this could be because of imbalance between family size and resource (Table 8).

Results of multivariate Logistic regression analysis for thinness

School children from families who did not produce and consume rice ore frequently were 2.2 times more likely to be thin. Those families who were producing rice were known to have cash crops and complement other needs and food security status of such families is believed to be good as reports of the district show. School children who did not receive vaccination service were more 1.55 times more likely to be thin. Those from families who did not have latrine were 1.5

Types of parasite	Ascaris lumbricoides	Hookworm	Trichuris trichiura	Schistosomia mansoni	Others types of parasites (Taenia worm, *H.nana*, *E.Vermicularis*)
Percent (n)	26.7% (211)	32.9% (260)	0.3 (2)	14.1% (111)	6.3% (50)

Table 5: Prevalence of parasitic infection among school children.

Parasite		Nutritional status								
		HAZ			WAZ			BAZ		
		Normal	Stunted	Total	Normal	Underweight	Total	Normal	thin	Total
Ascaris L	No	185	394	579	483	96	579	169	410	579
	Yes	53	158	211	170	41	211	73	138	211
Hookworm	No	164	366	530	438	92	530	164	366	530
	Yes	74	186	260	215	45	260	78	182	260
S.mansoni	No	203	476	679	557	122	679	211	468	679
	Yes	35	76	111	96	15	111	31	80	111
Others	No	607	133	740	607	133	740	231	509	740
	Yes	46	4	50	46	4	50	11	39	50

Table 6: Undernutrition (stunting, underweight and thinness) by parasitic infection among full cycle primary school children at Fogera district, Northwest Ethiopia, September to October, 2012.

Variable	Nutritional status		Crude Odds Ratio (95% Confidence Interval)	Adjusted Odds Ratio (95% Confidence Interval)
	Underweight	Normal		
FAMILY SIZE				
2-5	28	196	1	
6-8	91	420	1.52(0.96-2.39)	2.356 (1.13-4.92)*
>8	18	37	3.41(1.71-6.78)***	
immunization				
Yes	55	322	0.70(0.47-1.00)	0.65 (0.42-0.99)*
no	82	331	1	
Morbidity				
yes	5	22	1.09(0.40-2.92)	4.28(1.38-13.27)*
no	132	631	1	
Common crop				
Rice	16	313	0.14(0.08-0.25)***	0.11(0.06-0.21)***
others	121	340	1	
Family radio				
Yes	108	219	0.53(0.34-0.83)**	0.55(0.33-0.93)*
No	29	434	1	

Table 7: Results of multivariate Logistic regression analysis for underweight among full cycle primary school children at Fogera district, Northwest Ethiopia, September to October, 2012.

times more likely to be thin. Both vaccination and latrine availability and unitization are protective from vaccine preventable infections and diarrheal diseases (Table 9).

Discussion

Factors significantly associated with underweight

Prevalence of underweight was found to be 59.7% which is lower than prevalence of a study done in Kenya which was found to be 72% (p<0.05) and higher than the prevalence found in Cameroon which was 22.2% (p<0.046). Yet, it is much higher than the prevalence of a study conducted in Botswana which is 15.6% [22].

Children from families who most frequently produce rice were less likely to be underweight than those from families who do not produce rice most frequently (p=0.000, OR=0.11; 95%CI=0.06). Rice is believed to be rich source of carbohydrate and important macro nutrient for children. Children from families of >8 members were more likely to be underweight than from families 2-5 members (p=0.025, OR=2.36, 95%CI: 1.13-4.92); and in a similar study done in Sudan, family size was found to be associated with underweight [23].

This could be as a result of the difference in quality of care and feeding practices among big and small sized families.

The prevalence of this study is higher than the prevalence of a study conducted in Ghana with prevalence rate of 7.6% and similarly, ownership of radio was found to be protective against underweight [24].

This could be because families with radio might get better information on health and nutrition, feeding practices and care for children.

Children with a history of infection over the previous two weeks from the date of data collection time were 4.28 times more likely to be underweight than who did not have (p=0.012, OR=4.28; 95%CI=1.38 – 13.27).

Nutritional status of school children that infection was significantly associated with undernutrition [25,26].

Children who got vaccinated were less likely to be underweight than who did not receive vaccination only (p=0.048, OR=0.65 95%CI=0.42 – 0.99). Similarly, a study conducted in Kenya on prevalence and predictors of underweight revealed that vaccinated children were at a lesser risk of underweight, but the prevalence was lower (9%) as compared to the present study [27].

This could be because children might not had vaccine preventable diseases, this in turn might have reduced infection and thereby malnutrition.

Factors significantly associated with stunting

In this study, the prevalence of stunting is higher (30.7%) than the prevalence of stunting in a study conducted in Adama, which was found to be 12.6% [9]. However, the prevalence of stunting is lower than the prevalence of stunting of a study conducted in Kenya which was found to be 51% [28].

The observed difference might be due to the setting difference, being urban and rural and majority of malnutrition is contributed by rural community. As compared to children with families who do not most frequently produce rice, children with families who most frequently produce rice were found to be less likely to be stunted (p=0.000, OR=0.45; 95%CI=0.30 – 0.67). This is to mean that frequent harvesting and consumption of rice is preventive from stunting by 55%. This is in line with the finding of a study conducted in Democratic peoples of Republic of Korea (DPRK) on analyzing causes of child stunting (p<0.0001, Chi square=45.037) that rice consumption was found to be protective from stunting [29].

As compared to children from families with 2-5 members, children from families with 6-8 members are 1.48 times more likely to be stunted. (p=0.030, OR=1.48; 95%CI=1.04 – 2.11). In a similar fashion,

Associated factors for stunting				
Variable	**Stunting**		**Crude Odds Ratio (95% Confidence Interval)**	**Adjusted Odds Ratio (95% Confidence Interval)**
	Stunted	Normal		
Common crop				
Rice	200	129	0.48(0.35-0.65)	0.45(0.30-0.67)
others	352	109	1	1
Family size				
2-5	143	81	1	1
6-8	369	142	1.47(1.02- 1.77)	1.48(1.04- 2.11)
>8	40	15		

Table 8: Results of multivariate Logistic regression analysis for stunting among full cycle primary school children at Fogera district, Northwest Ethiopia, September to October, 2012.

Variable	**Thinness (Low BMI for age)**		**Crude Odds Ratio (95% Confidence Interval)**	**Adjusted Odds Ratio (95% Confidence Interval)**
	Thin	**Normal**		
Common crop				
Rice	291	170	1	1
others	257	72	2.09 (1.51-2.88)	2.20 (1.56-3.11)
Immunization				
Yes	269	144	1	1
no	279	98	1.52 (1.12-2.07)	1.55 (1.13-2.14)
Latrine availability				
Yes	274	147	1	1
No	274	95	1.55 (1.14-2.11)	1.50 (1.09-2.06)

Table 9: Results of multivariate Logistic regression analysis for thinness among full cycle primary school children at Fogera district Northwest Ethiopia, September to October, 2012.

a comparative cross sectional study on nutritional status among school girls done in Sudan showed that family size was significantly associated with stunting ($p<0.05$) [23].

However, the prevalence of stunting in this study among girls is 32.2% which is lower than the prevalence of the stunting found in Sudan's study, which was 47.7% [23].

This might be due to the difference in quality of care and feeding practices for children and resource of the family. The difference of the two prevalences could be seasonal variations in which the two studies were conducted.

Factors significantly associated with thinness (Low BMI for age)

The prevalence of thinness was 37.2% which is higher than a prevalence of thinness in a study conducted in Sudan with a prevalence rate of 2.1% [23]. In addition, the prevalence of the present study is much higher than the prevalence of a study conducted in China which was found to be 6.71% [30].

Children from families who did not produce rice most frequently were more likely to be thin ($p<0.000$, OR=2.20, 95%CI: 1.56-3.11). In this study children from families who did not have latrine were more likely to be thin ($p=0.013$, OR=1.50, 95%CI: 1.09-2.06). Unvaccinated children were more likely to be thin ($p=0.007$, OR=1.55, 95%CI: 1.13-2.14). It could be because having latrine may prevent diarrheal diseases which are believed to be the immediate causes of malnutrition.

In this study, none of the parasites was found to be significantly associated with malnutrition among school children ($p>0.05$). This might be due the reason that the intensity of parasites was light to moderate and it could also be newly acquired infection.

Conclusion

Malnutrition (stunting, underweight and thinness) remains pervasive among the study population throughout the study area. Various interacting immediate and distal factors like frequent rice production, vaccination, ownership of radio, family size and infection/morbidity and latrine availability were found to be significantly associated with malnutrition. In addition, parasitic infections which negatively impact the health and nutritional status of school children were found to be highly prevalent and need integrated management of diseases through workable strategies. Therefore, tackling undernutrition in rural areas requires a holistic approach, especially when targeting populations of school-age children through vaccination, rice production and consumption, family planning, infection prevention, treatment and control, latrine construction and utilization and by promoting information gaining on radio. School children should also get targeted for deworming.

Competing Interests

The authors declare that they have no competing interest.

Authors' Contribution

Author 1: Hunegnaw Mekonnen :Initiated the research, wrote the research proposal, conducted the research, did data entry and analysis and wrote the manuscript, Author

Author 2: Takele Tadesse: Involved in the write up of the proposal, the data analysis, and write up of the manuscript.

Author 3: Teresa Kisi: Involved in the write up of the proposal, the data analysis, and write up of the manuscript.

All authors read and approved the final manuscript.

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