ORIGINAL ARTICLE

Malnutrition and Parasitic Infections among Primary School Children in the Volta Region of Ghana

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ABSTRACT

Background: Notwithstanding the momentous improvements in the nutritional status of children in sub-Saharan Africa, malnutrition continue to persist as a serious public health issue. Malnutrition often result from poor socioeconomic condition and infections, especially malaria and helminth infections. Majority of Ghanaian children live in poor rural areas endemic for malaria and helminths.
Aim: To evaluate the burden of malnutrition and the influence of poor socioeconomic factors and parasitic infections among primary school children in the Volta Region of Ghana.
Methods: A cross-sectional study in 3 districts of the Volta Region, involving 550 school children aged 6 to 14 years was conducted. Information on the demography, socioeconomic status, nutritional assessment were collected from the children. Their nutritional status were assessed using anthropometric methods, and analysed using the WHO Anthro-Plus software and expressed as height-for-age, BMI-for-age and weight-for-age. Malaria, intestinal helminths and *Schistosoma haematobium* detections were determined using rapid diagnostic test (RDT), Giemsamicroscopy, wet mount and sedimentation method respectively.
Results: The prevalence of stunting among study participants was 42.5% while 12.9% were overweight. Stunted children were significantly (p=0.04) older (mean age, 11.39±2.32) than their overweight colleagues (9.96±1.65). There was no significant difference in the malaria (p=0.08), *S. haematobium* (p=0.40) and intestinal parasitic infections (p=0.86) statuses of the children with malnutrition. Though children in the primary schools were all at risk of stunting, children from Davanu had the highest risk of stunting, with adjusted OR of 4.68(95% CI, 2.46-8.91; p<0.001). Also, children who stay with their fathers only had the highest risk of stunting
Conclusion: Poor socio-economic circumstances contributed more to malnutrition than parasitic infections in this study. Nutritional interventions should target vulnerable children with poor socioeconomic status.
Keywords: Malaria, Parasitic infections, malnutrition, school-aged children, Ghana

INTRODUCTION

Malnutrition is a serious public health issue affecting mainly children in developing countries. It manifests in children as stunting, wasting, underweight or overweight. Global statistics in 2017 showed that among children under 5 years of age, close to 152 million were stunted, 51 million wasted and 38 million overweight[1].

Malnutrition in children, an aberration in the nutritional balance, is caused by factors that disrupt nutrient intake, absorption and utilizations. These factors are usually biological, social, cultural and economic related, and can be summed up as either infections or socio-economic factors. Recurrent parasitic infections, like malaria and helminth infections can lead to malnutrition by impairing either intake, absorption or utilization of nutrients[1,2,3,4]. Socioeconomic factors which influence household income like parents' illiteracy, especially mothers' education and occupations, have been found to significantly influence malnutrition in children[5,6]. These factors cause malnutrition by decreasing the availability, provision and intake of nutritious diets.

Malnutrition is a burden among children in Ghana with a considerable number of them stunted, underweight or wasted[7,8]. Though the country has made some marginal improvement in lowering malnutrition, children are still at risk since majority of them live in rural areas with poor socioeconomic factors, which are also endemic for malaria and helminth infections[7,8,9]. Thus, this study aimed at evaluating the burden of malnutrition, and the influence of poor socioeconomic factors and parasitic infections in the Volta Region of Ghana.

METHODS

This was a cross sectional study involving 550 primary school children aged between 6 and 14 years, from 3 districts in the Volta region of Ghana. The Ho municipality, Adaklu and Agotime-Ziope districts were purposefully selected for the study out of the 25 districts in the region to reflect an urban and two rural densely-populated settings. The region is located in the south-eastern part of the country and is bounded by Togo on the east and the Volta Lake and the Eastern region on the west.

Sampling Technique and Study Population: Five primary schools were purposely sampled from these densely populated areas: one from the urban settlement (Ho Municipality) and two each from the rural districts (Adaklu and Agotime-Ziope). Primary school children who were present in school during sample collection and who gave their assent were recruited into the study. Parental/guardian consent was also sought.

Ethical clearance: The Ghana Health Service Ethical Committee gave ethical clearance and approval [GHS-ERC: 29/11/15) for this study. Permission was sought from the authorities of the five schools. The parents of the children who participated in this study also gave their written inform consent, while the children signed the assent forms before being enrolled onto the study.

Data collection: Information on the demography, socioeconomic status, nutritional assessment and malaria status were collected from the primary school children in a one-time encounter between the hours of 9:30 AM to 2 PM each day.

Demography and socioeconomic status: Questionnaire administration was done among children enrolled for this study. Questions were asked about their demographic and socio-economic status vis-à-vis: age, sex, and occupation of both parents, as well as the identity of the guardian the children stayed with Anthropometric measurements

Children's weights were measured using an electronic bathroom scale. Weight was measured after children removed shoes, socks and any other heavy object. Weight was measured to nearest 0.1kg. The height of the children was measured to the completed centimetre using a stadiometer. These measurements were expressed as height (height for-age**)**, Body mass index (BMI) (BMI-for-age**)** and weight (Weight-for-age). Nutritional status of the primary school children in this study were calculated using the recent World Health Organization child growth standards with WHO 2007AnthroPlus software[10].

Determination of Parasitic Infections: Detection of malaria parasite, ova of intestinal helminths and *S. haematobium* infections have been described in earlier works[11,12]. Briefly, blood, stool and urine samples collected from the children were transported in an ice chest to the laboratory on the same day for further analysis. Malaria detection was done using Bioline SD Rapid Diagnostic Test (RDT) (Standard Diagnostics, INC., South Korea) and Giemsa microscopy. RDT kit was specific for histidine rich protein 2 (HRP-2) of *P. falciparum.* Microscopy employed 10% Giemsa preparation of thin and thick film on a slide; and the slides were read by two microscopists. Where there were discordant results, a third microscopist was engaged to resolve the variance between the earlier two. Wet mount was used to detect the ova of intestinal helminths (i.e., Ascaris, Hookworm and Protozoa) in the stool sample. This involved mixing a small portion of the stool sample with few drops of normal saline on a slide and subsequently viewing the specimen under a microscope. Ova of *S. haematobium* were detected using sedimentation method which involved centrifuging a sample of urine for 2

minutes at 2000 times gravity (xg),and the sediments viewed under a microscope.

Definitions

Malnutrition: In this study stunting was defined as height for-age value below minus 2 standard deviation of normal, underweight/ thinness as BMI-for-age/Weight-for-age value below minus2 standard deviation of normal and overweight as BMI-for-Height value above plus 2 standard deviation of normal.

Malaria diagnosis: A child is said to be infected if either RDT is positive or the presence of asexual forms of the parasite in the blood smear is detected.

Statistical Analyses: A frequency distribution was done for all the socioeconomic and demographic characteristics of the primary school children in the study, as well as *P. falciparum*, stunting underweight/thinness and overweight. Pearson chi-square tests analysis was used to investigate the association between socioeconomic factors, parasitic infections and malnutrition in the children. Multivariate logistic regression was used to identify factors independently associated with the risk of malnutrition.

Analyses were done with 95% confidence interval (CI) and p-value of 0.05 and below was considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics version 21.0 (IBM Corporation, Armonk, NY, USA).

RESULTS

Out of the 550 primary school children, 234(42.5%) of them were stunted, 42(7.6%) were underweight and 71(12.9%) were overweight (Table 1). Overweight children significantly (p=0.04) had the lowest mean age (9.96±1.65), compared to those who are stunted (11.39±2.32) and those who were underweight (11.53±2.78) (Table 1). A significant (p=0.043) proportion of the children whose mothers are farmers (156) were stunted (76, 48.7%). School children from Dave and Davanu Primary Schools were significantly (p ≤ 0.001) more stunted (Dave, 46, 54.8%; Davanu,61, 77.2%),as showed in Table 1. There was no significant difference in the malaria (p=0.08), *S. haematobium* (p=0.40) and intestinal parasitic infections(p=0.86) statuses of the children with malnutrition (Table 2). Further stratification of the children using sex showed a significant number of stunted girls (69.35%, p=0.023) in Freetown primary school in the Ho municipality (Fig. 1).

Table 3 shows the possible predicted factors that influence the risk of stunting in children in this study. Children in the primary schools were all at risk of stunting, although children from Davanu had the highest risk of stunting with unadjusted OR of 4.82 (95% CI 2.64-8.82; p<0.001). This significance remained after adjusting for sex, occupation of parents and who the child stays with [adjusted OR of 4.68(95% CI, 2.46-8.91; p<0.001)]. Children who stay with their fathers were also found to have the highest risk of stunting (Unadjusted OR, 3.8; p=0.01; Adjusted OR, 3.7; p=0.013).

Table 1: Sociodemographic characteristics of children stratified by malnutrition status

Characteristics	Stunting (234)%	Underweight (42)%	Overweight (71)%	P value
Age (yrs.) Mean ± SD	**11.39±2.32**	**11.53±2.78**	**9.96±1.65**	**0.04**
Gender				
Male [249]	103(41.4)	23(9.2)	27(10.8)	0.33
Female [301]	131(43.5)	19(6.3)	44(14.6)	
Occupation of father				
Trader [254]	102(40.2)	18(7.1)	33(12.9)	0.80
Farmer [170]	78(45.9)	13(7.6)	19(11.2)	
Civil servant [103]	44(42.7)	9(8.7)	15(14.6)	
Unemployed [23]	10(43.5)	2(8.7)	4(17.4)	
Occupation of Mother				
Trader [334]	140(42.0)	28(8.4)	46(13.8)	0.043
Farmer [156]	76(48.7)	10(6.4)	22(14.1)	
Civil servant [34]	10(29.4)	2(5.9)	2(5.9)	
Unemployed [26]	8(30.8)	2(7.6)	1(3.8)	
Primary School				
Dave [84]	46(54.8)	7(8.3)	15(17.9)	≤0.001
Davanu [79]	61(77.2)	8(10.1)	21(26.6)	
Freetown [125]	47(37.6)	5(4.0)	12(9.6)	
Afegame [123]	48(39.0)	10(8.1)	17(13.9)	
Kpetoe [139]	32(23.0)	12(8.6)	6(4.3)	
Who child stays with				
Father [25]	14(56.0)	3(12.0)	5(20.0)	0.54
Mother [80]	26(32.5)	11(13.8)	9(11.3)	
Both parents [318]	144(45.3)	19(6.0)	43(13.5)	
Grandparents [70]	36(51.4)	6(8.6)	8(11.4)	
Others [57]	14(24.6)	3(5.3)	6(10.5)	
Family size				
<4 [189]	68(36.0)	13(6.9)	21(11.1)	0.06
4 [106]	42(39.6)	10(9.4)	16(15.1)	
>4 [255]	124(48.6)	19(7.5)	34(13.3)	
Malaria status				
Pf +ve [383]	141(36.8)	23(6.0)	40(10.4)	0.08
Pf –ve [167]	93(55.7)	19(11.4)	71(42.5)	

Data is presented as frequency with corresponding percentage in parenthesis. p is significant at **0.05.**

Table 2: Parasitic infection status vs. nutritional status

Infections	Stunting (234)%	Underweight (42)%	Overweight (71)%	P value
Malaria				
Pf +ve [383]	141(36.8)	23(6.0)	40(10.4)	0.08
Pf -ve [167]	93(55.7)	19(11.4)	71(42.5)	
S. haematobium				
Present [57]	23(40.4)	4(7.0)	6(10.5)	0.40
Absent [493]	211(42.8)	38(7.7)	65(13.2)	
Intestinal parasites				
Ascaris [7]	2(28.6)	2(28.6)	0(0)	
Hookworm [5]	3(60)	0(0)	2(40.0)	0.87
Protozoa [11]	5(45.5)	0(0)	1(9.1)	
Absent [527]	224(42.5)	40(7.6)	68(12.9)	

Data is presented as frequency with corresponding percentage in parenthesis. p is significant at **0.05.**
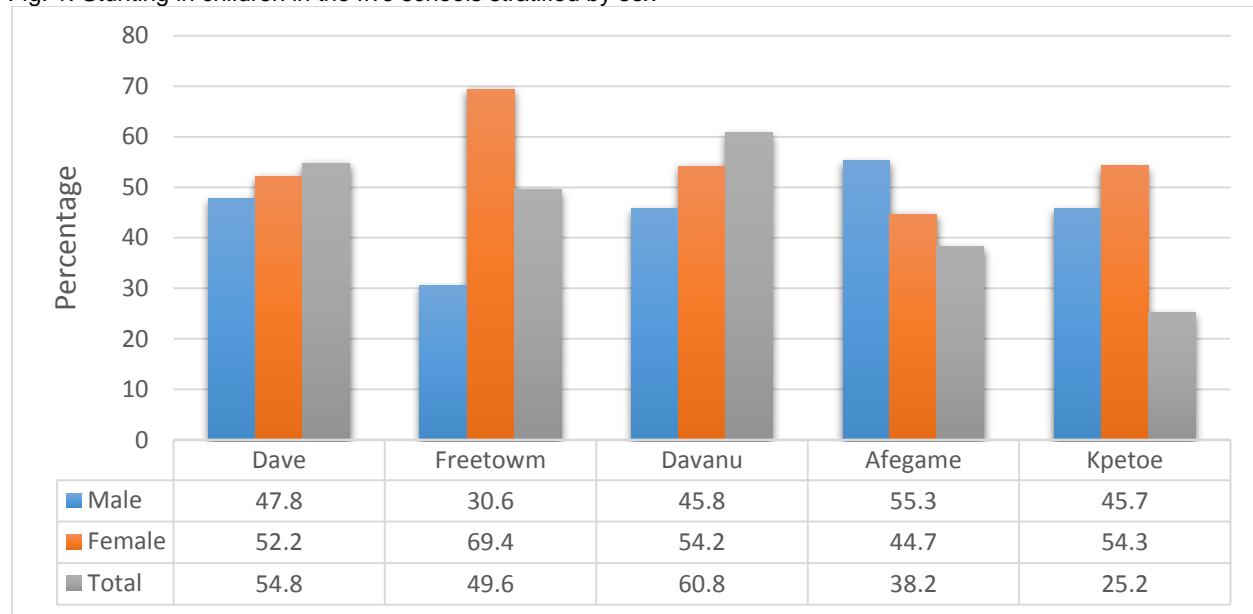
Table 3: Multivariate logistic regression analysis of stunting risk among the primary school children.

Variable	Unadjusted or (95% ci)	P value	Adjusted or (95% ci)	P value
Gender				
Male	0.91(0.65-1.30)	0.6	0.93(0.65-1.33)	0.7
Female	Ref	Ref	Ref	
School				
Dave Primary	3.84(2.14-6.91)	<0.001	3.20(1.72-5.95)	<0.001
Freetown Primary	3.10(1.82-5.26)	<0.001	2.79(1.62-4.79)	<0.001

Davanu Primary	4.82(2.64-8.82)	<0.001	4.68(2.46-8.91)	<0.001
Afegame EP	2.04(1.19-3.49)	0.01	2.32(1.29-4.15)	0.003
Kpetoe EP	Ref	Ref	Ref	
Who child stays with				
Father	3.80(1.38-10.54)	0.01	3.77(1.32-10.75)	0.013
Mother	1.50(0.68-3.20)	0.3	1.37(0.61-3.07)	0.45
Both parents	2.73(1.41-5.29)	0.003	2.46(1.25-4.85)	0.009
Grand parents	3.42(1.57-7.59)	0.002	3.68(1.65-8.25)	0.001
Others	Ref	Ref	Ref	
Occupation of mother				
Trader	1.88(0.77-4.63)	0.16	1.64(0.65-4.16)	0.3
Farmer	2.44(0.97-6.18)	0.06	2.25(0.86-5.87)	0.09
Civil servants	0.93(0.29-2.95)	0.9	0.95(0.29-3.13)	0.93
Unemployed	Ref	Ref	Ref	

OR=odds ratio, CI=confidence interval, Ref= Reference. P is significant at 0.05

Fig. 1: Stunting in children in the five schools stratified by sex

	Dave	Freetowm	Davanu	Afegame	Kpetoe
Male	47.8	30.6	45.8	55.3	45.7
Female	52.2	69.4	54.2	44.7	54.3
Total	54.8	49.6	60.8	38.2	25.2

DISCUSSION

The prevalence of stunting and underweight/thinness in this study was 42.5% and 7.6% respectively. Stunting represents chronic malnutrition, resulting from a prolonged history of nutrient deprivation and other factors like poor environmental and social conditions[13]. Under nutrition and thinness on the other hand depicts acute malnutrition, a state of current deprivation of nutrients and calories leading to failure to gain weight[13,14]. The higher prevalence of chronic malnutrition in this study was also reported in rural Ivory Coast[15] and Cameroon[16].

The prevalence of overweight was 12.9% in this study. Overweight and obesity have been reported by some studies in Ghana[17,18,19]. Females were more overweight than males in this study; which is in agreement with studies done in other parts of Africa[18]. Overweight is said to be malnutrition in every respect; posing serious implication on health, and putting pressure on the heart, kidneys and liver[18]. It is strongly believed that most cases of adult obesity started during childhood[20]. Overweight was hitherto thought to be a disease of affluence, but gradually this belief has reversed as its prevalence is on the rise in

developing countries[18,21]. Overweight can often be seen with underweight, stunting and wasting in the population[22,23], a situation termed "double burden of malnutrition[24,25]".

Children from Dave and Davanu Primary schools from Adaklu districts were significantly more stunted; with children from Davanu primary school having the highest risk of stunting. Children who stay with their fathers' only and their grandparents had the highest risk of stunting. All these findings suggest that poor socio-economic factors, as seen in rural areas, and inadequate parental care contributed greatly to malnutrition in children in these study areas[26,27,28].

P. falciparum infection was not significantly associated with stunting, underweight/thinness and overweight in this study. This finding was similar to studies done in other West African countries and South America[15,29]. These results/findings suggest that socioeconomic factors probably contributed more than*P. falciparum* infection in causing malnutrition in the children in this study;as the aetiology of malnutrition is multifactorial with a complex mechanism of infections and socioeconomic factors[30,31].

CONCLUSION

Stunting was a significant type of malnutrition found among children in this study, followed by overweight. Poor socioeconomic situation contributed significantly to malnutrition than parasitic infections in this study. More nutritional interventions are needed to prevent malnutritionin vulnerable groups of children with poor socioeconomic status.

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