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Association between malnutrition and some water, sanitation and hygiene (WASH) factors among school children in Gombe State, Nigeria

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Abstract

The state of the environment in which we live and certain hygienic practices we indulge in has been known to affect our nutritional status. This study was aimed at examining the association between malnutrition and some selected water, sanitation and hygiene (WASH) practices among school children in Gombe State Nigeria. A cross sectional survey was conducted between March and June, 2019. A total of 745 pupils were selected from 12 public and 6 private schools across 6 LGAs in Gombe state, using multi-stage sampling technique. Anthropometric measurements of heights and weights of the study participants were done using standard instruments and procedures. Other relevant data (age, sex, some environmental variables etc) were collected using a structured template. Data analysis was done using IBM SPSS version 21 and key variables were presented using descriptive statistics, while associations were tested using Chi square. Odd ratio (OR) was used to estimate risks of malnutrition among the subjects and p-value was set at 0.05. The pupils had a mean age of 9.96±2.26 years, 50.9% of whom were males the rest being females. Though 84.6% of them had toilets in their residences not all of them (98.6%) put them to use. A good proportion (79.1%) dispose their refuse by dumping and slightly more than half of them (51.7%) have access to pipe borne water. And though only two (method of refuse disposal and source of drinking water) out of the eight WASH variables studied were found to be associated with underweight (Composite indicator of malnutrition), all the eight variables were found to be associated with stunting (chronic malnutrition). Overall, 20.8% and 22.4% of the subjects were underweight and stunted, respectively. The foregoing raises a germane concern about the role of WASH in malnutrition among school children and the need for a comprehensive and sustainable school feeding programme in the state and country at large. There should also be an integration of a WASH component in all nutrition intervention programmes.

Keywords: Malnutrition; Underweight; Stunting; WASH; Association; School Children

1. Introduction

Globally, about 52 Million (8%) of children under-five (U5) are wasted, and 155 Million (23%) stunted [1]. An estimate of 9.6 Million U5 children are stunted and wasted in Africa and under-nutrition explains around 45% of deaths among U5 children [2]. The most recent demographic and health survey reveals that in Nigeria 37% of children U5 are stunted, 7% wasted and 22% underweight [3]. According to the survey in north eastern (NE) Nigeria 49.1% U5 children are stunted, 9.7% wasted and 29.9% underweight while in Gombe State 51.2% U5 children are stunted, 7.8% wasted and 30.4% underweight. These childhood nutritional problems later tends to reflect negatively on the school age child and adolescent's nutritional status [4]. An estimated 2.3 billion people lack basic sanitation service and about 892 million

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people practice open defecation worldwide, while an estimated 844 million people do not have access to improved water sources [5]. The situation is worst in Sub-Saharan Africa and the developing countries. In Nigeria only 64.2%, in the NE 52.4% and in Gombe State 39.4% people have access to improved water sources [6]. Again in Nigeria only 51.6%, in the NE 49.3% and in Gombe State 46.7% of people have access to improved sanitation [6].

One-third of all undernourished children worldwide reside in Sub-Saharan Africa (SSA) [7]. Nigeria is experiencing significant challenges to provide access to improved Water, sanitation, and hygiene (WASH) to the population [8]. And about 56 % of malnutrition is associated with inadequate WASH [9]. Poor state of WASH help in the spread of infectious diseases and intestinal worms (nematode infection), diarrhea etc. [4, 10, 11]. Diarrhoea can be considered as a cause and consequence of malnutrition. The foregoing encourage the development of environmental enteric dysfunction (EED) or environmental enteropathy (EE) [4]. EE is an inflammatory condition of the gut of children which is characterized by villous atrophy and malabsorption of digested food thereby causing under-nutrition. Some of the negative impacts of chronic malnutrition (stunting) in early life include high mortality, decreased cognitive development, poor school performance, and reduced productivity in adults [9]. However, more research is needed to confirm the relationship between malnutrition and WASH [12].

Some of the negative impacts of chronic malnutrition (stunting) in early life include high mortality, decreased cognitive development, poor school performance, and reduced productivity in adults [9].The increase in child under-nutrition with age could be as a result of increased interaction of the older children with the environment which may lead to increased exposure to childhood diseases either through consumption of contaminated foods, drinking water from unimproved sources or poor environmental sanitation [7]. And in view of the fact that one-third of all undernourished children worldwide reside in Sub-Saharan Africa (SSA), this study sought to assess the association between malnutrition (underweight and stunting) and water sanitation and hygiene (WASH) practices among school children in Gombe State, Nigeria.

2. Material and methods

2.1. Study Area

This study was conducted in Gombe State, north eastern Nigeria. The state is located between latitudes 90°30’ and 12°30’ N, longitudes 8°45’ and 11°45’ E. Some other Nigerian states that share borders with Gombe State include: Yobe state to the north, Bauchi state to the west, Taraba State to the south while Borno and Adamawa states are neighbouring states to the east. Gombe state is made up of eleven local government areas (LGAs) that form three geo-political districts - northern, central and southern senatorial districts. A total of eighteen (18) primary schools scattered across the six LGAs were involved in this study. As at the year 2017 Gombe State had an estimated projected population of 3,256,962 and a landmass area of 20,265 square kilometers [13].

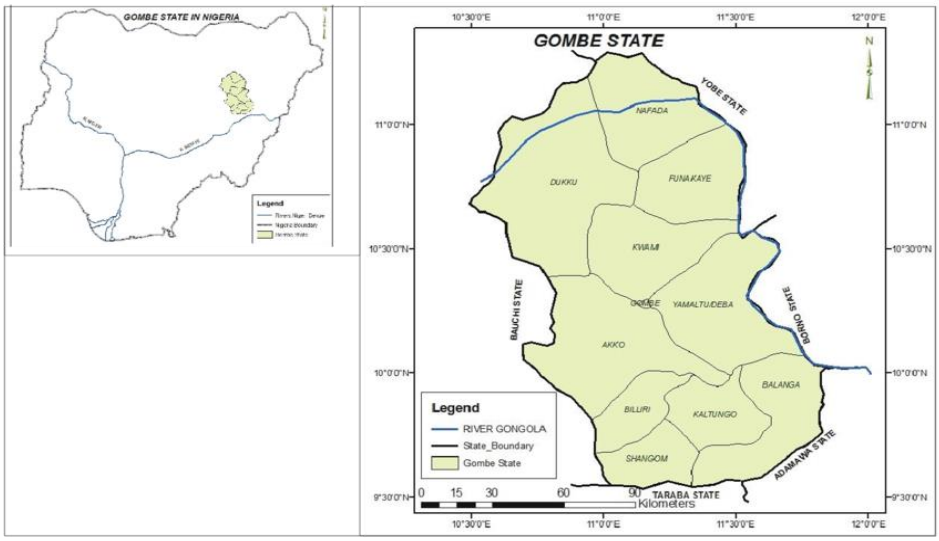

Figure 1 Map of Gombe State

2.2. Target Population and Population of the study

The target population for this study comprised all children enrolled in all public and private primary schools of Gombe State. As at the time of data collection a total of 492, 962 pupils were enrolled in 1, 914 Primary Schools in Gombe state [14]. This figure can be disaggregated into one thousand three hundred and fourty one (1, 341) public and five hundred and seventy three (573) private primary schools in Gombe State. On the other hand the population of study consist of all school children in the 18 public and private primary schools selected from the urban and rural areas of Gombe state (see Fig. 1).

2.3. Study Design

This study was a descriptive cross sectional survey.

2.4. Eligibility Criteria

All school children within the age group of 6 - 15 years who were enrolled in the selected primary schools in Gombe State and all those who were present in the schools at the time of the survey were eligible. Also eligible were school children who may have stayed in the state for at least a year.

2.5. Study Participants

The study participants were selected primary school pupils aged 6-15 in Gombe state.

2.6. Sample Size Determination

The sample size for this study was determined using the sample size formula for comparing two proportions [15].

$n = [P1\ (1 - P1)\ +\ P2\ (1 - P2)]\ (Z\alpha/2\ +\ Z\ \beta)2\ /(P1 - P2)2$

Where:

n: required sample size

$P1$: estimated proportion for malnutrition in urban areas (about 12%) [6]

$P2$: estimated proportion for malnutrition and malaria in rural areas (comparison group) in the North East (about 36%) [6]

α: level of statistical significance

$Z\alpha/2$: Represents the desired level of statistical significance (usually 1.96 for $\alpha = 0.05$)

Z β: Represents the desired power (estimated to be 0.84 for 80% power)

n for each group *2= total sample (i.e. for the 2 groups)

The calculations ensured that the minimum detectable difference in malnutrition among the school children in rural and urban areas, or in public and private schools; was 10%.

The calculated minimum sample size for the study was 295 pupils from urban schools and 295 from rural schools. Put together a minimum sample size of 590 was determined. However, this was adjusted upwards to a final sample size of 745.

2.7. Sampling Technique

Multistage sampling technique was employed to select the subjects for this study. The total number of Primary schools in Gombe state was estimated at 1, 914. This comprised 573 private and 1, 341 public primary schools [14], implying that the ratio of private to public schools was 1:2.3. Hence, 6 private and 12 public primary schools were purposively selected from both urban and rural areas of the state. From the selected schools a sample of 745 children were selected in stages. Firstly, two LGAs were selected from each senatorial district using simple balloting. In the second stage three primary schools - a public primary school from a rural area and a public and a private school from an urban or a suburban area - were selected per LGA. This added up to a total of 18 schools that were selected. In each primary school

(stage three) four classes were conveniently selected from among any of primary one to primary six. In the final stage (stage four), at least 10 subjects were systematically picked from each of the 4 classes (40). At any stage the subjects were free to drop out of the study.

2.8. Ethical approval

An ethical approval and clearance for this study was obtained from the Gombe State Ministry of Health Research and Ethics Committee (GSMoHREC) – Ref: MoH/ADM/S/658. In addition, consents of the heads of the 18 schools that participated in the study, the parents and the volunteering pupils were all secured before conducting the study on the children. The study was conducted in tandem with the Helsinki Declaration.

2.9. Data Collection

Face-to-face interview and anthropometric measurements for malnutrition were used for the data collection. And the exercise was conducted between March and June, 2019.

2.9.1. Face to face Interview

A face-to-face oral interview was first conducted with each of the subjects to collect socio-demographic and other information related to malnutrition using a validated questionnaire/data collection template.

2.9.2. Anthropometric Measurements for Malnutrition

Anthropometric measurements were then carried out on all the subjects using standard procedures as described by Jelliffe [16]. The instruments used include: portable wall measuring rod (stadiometre), calibrated in centimeters for measurement of height; HANA bathroom weighing scale with readings taken to the nearest 0.5kg. To validate the instrument and ensure reliability, a pilot study was carried out in one of the public primary schools not selected for the main study using the same instruments and procedures that were later used during the main data collection exercise.

2.10. Data Management and Analysis

Out of a total of 748 instruments retrieved, 745 were assessed and found be complete and usable. Data analysis was done using IBM Statistical Package for Social Sciences (SPSS) version 21 (SPSS Inc. Chicago, IL, USA). Both descriptive and inferential statistics were used to summarize and make inferences on the data. Chi square (χ^2) and odd ratio (OR) were computed and used to compare proportions and estimate risks of malnutrition among the subjects. Findings were considered significant at P-values less than 0.05. Data were presented in tables. The indicators of children's nutritional status that were used for this study included stunting and underweight which were obtained from anthropometric measurements (height and weight) and their corresponding ages from oral interview. Height for age z-score (HAZ), weight for age z-score (WAZ) and weight for height z-score (WHZ) were calculated WHO AnthroPlus software [17].

3. Results and discussion

3.1. Background (Demographic and WASH) information about the Participants

Findings from this survey shows that study participants had a mean age of 9.96±2.26 years and an average family size of 7.47± 2.425 persons (Table 1). The school children studied fall within a mean birth order of 3.37±2.325 and about half (50.9%) of them were males and the rest (49.1%) were females (Table 1). Though toilets were available in 86.4% of pupils' households, not all (98.6%) make use of them (Table 2). Some (18.0%) of the respondents use shared toilet with neighbours. These figures are way far higher than the national figures where only 56% of Nigerian households use improved toilet facilities [18]. The finding is also higher than another finding from Ibadan, south west Nigeria where the use of improved latrine was put at 54% [19]. A proportion (12.4%) of the respondents stay in rented houses as another good majority (79.1%) admitted practicing open dumping as a method of waste disposal. Again, this is higher than those from the study in Ibadan - 41.2% [19]. Only about a half (51.7%) of the respondents had access to improved (Pipe borne water) source of drinking water. This finding is slightly higher than the one reported in the most recent national demographic and health survey conducted in 2018, which is 43% for Gombe state [18]. Contrarily, the overall national average of 66% households that have access to an improved source of drinking water (74% in urban areas and 58% in rural areas) is higher than the reported in this study [18]. Almost half (48.5%) of the children stay in houses that have drainage or that are not water-logged, while 53.3% of them stay in cement/bricks houses.

3.2. Association between Malnutrition and Some WASH Factors

Several studies in Nigeria and elsewhere have demonstrated strong association between the different forms of malnutrition and some environmental and WASH factors [7-12, 20, 21].

3.2.1. Underweight (Malnutrition) and WASH Factors

The findings of this study seems to suggest that availability of toilet in residence, toilet being put to use, using shared toilet with neighbours, and type of residential facility appear not to be associated (P=<0.05) with underweight (Table 3). However, children from households practicing open dumping as a means/method of waste disposal recorded the highest prevalence of underweight (22.8%) at $\chi 2$ =10.673 and P=0.005. And children from households who had access to improved source of drinking water recorded significantly low burden of underweight (compared to those from households with unimproved i.e. Pipe borne water: 17.4% vs. well water: 26.9%, $\chi 2$ =10.997, P=0.012). This findings are consistent with findings from Tanzania by Mshida *et al* [22], and from Onitsa South eastern Nigeria by Ndukwu *et al* [23]. The pathophysiology of undernutrition due to prolong influence of unhygienic environmental factors via environmental enteropathy (EE) or Environmental Enteric Dysfunction (EED) and which triggers mal-absorption has been adequately described [12, 24-26]. This aptly explains the association between underweight and the WASH factors.

3.2.2. Stunting (Malnutrition) and WASH Factors

This study also demonstrates the existence of an association between stunting and water sanitation and hygiene (WASH) indicators (Table 4). Children from households without toilets (33.7%) were about twice at risk of being stunted than those from households with toilets ($\chi 2$ = 8.447, P=0.004, OR=1.946, CI=1.235-3.066). Children from households not using their toilets were also about twice more at risk of stunting than those from households putting their toilets to use (33.6%) to use ($\chi 2$ = 9.003, P=0.003, OR=1.958, C I= 1.255-3.055). Furthermore, children from households that don't take advantage of using a shared toilet (24.3%) were also more (twice) at risk of stunting than those that do ($\chi 2$ = 6.269, df = 1, OR=1.926, CI=1.145-3.239). Children that resided in houses owned by parents/guardians had high prevalence (23.5%) stunting than those in rented apartments ($\chi 2$ = 4.054, P=0.044, OR=0.537, CI=0.290-0.992). Children from households that disposed waste at dump sites carried the highest burden (24.5%) of stunting than those from households that disposed their waste more properly ($\chi 2$ = 8.499, P=0.014). Children from households with improved source of drinking water (portable/pipe borne water) had low prevalence (15.3%) of drinking stunting ($\chi 2$ = 23.473, p=0.000). This consistent association and link between stunting and negative WASH practices or factors are in tandem with several other studies [7, 12, 22, 23, 27]. And this could be due to the fact that compromised WASH factors could predispose to diseases which in themselves are among the immediate causes of malnutrition [28]. In another breath, poor state of WASH facilities could be indicators of poor socioeconomic status that could be potent drivers of inadequate dietary intake and consequently manifesting in malnutrition (stunting as an indicator of long term deprivation).

Table 1 Some socio-demographic information of study subjects

Variable	Frequency (n)	Mean± Std. Dev./%	Min	Max
Age of Child	745	9.96±2.26	6	15
Family Size	739	7.47± 2.43	1	15
Birth Order	745	3.37±2.33	1	13
Sex				
Male	379	50.9		
Female	366	49.1	-	-
Total	745	100.0	-	-

Table 2 Environmental factors (WASH Indicators) around the school children

S/N	Variable/Category	Frequency	Percentage
1	Availability of toilet in residence		
	No	101	13.6
	Yes	643	86.4
	Total	744	100.0
2	Toilet being put to use		
	No	9	1.4
	Yes	634	98.6
	Total	643	100.0
3	Uses shared toilet with neighbours		
	No	605	82.0
	Yes	133	18.0
	Total	738	100.0
4	Type of residential facility		
	Rented	92	12.4
	Owned by parent or guardian	652	87.6
	Total	744	100.0
5	Method of refuse disposal		
	Dumping	587	79.1
	Burning	74	10.0
	Burying	3	0.4
	Refuse collectors	67	9.0
	Dumping + Burning	11	1.5
	Total	742	100.0
6	Source of drinking water		
	Stream/river	60	8.1
	Well	108	14.5
	Water vendors/Truck pushers/Tanks	192	25.8
	Pipe borne water	385	51.7
	Total	745	100.0
7	House environment has drainage/ not water-logged		
	No	384	51.5
	Yes	361	48.5
	Total	745	100.0
8	Type of residential housing material		
	Cement/Brick	397	53.3
	Mud, cornstalk etc	348	46.7
	Total	745	100.0

Table 3 Association between malnutrition (underweight) and WASH Indicators

SN	Variable	Malnutrition (Underweight)		OR	CI	Chi Sq	df	F-Exact/ P-Value
		Yes (< -2)	No (-2+)					
		n (%)	n (%)					
1	Availability of toilet in residence							
	No	17 (16.8%)	84 (83.2%)					
	Yes	138 (21.5%)	505 (78.5%)					
	Total	155 (20.8%)	589 (79.2%)	0.741	(0.425-1.289)	1.135	1	0.287/0.356
2	Toilet being put to use							
	No	1 (11.1%)	8 (88.9%)					
	Yes	137 (21.6%)	497 (78.4%)					
	Total	138 (21.5%)	505 (78.5%)	0.453	(0.056-3.657)	0.58	1	0.446/0.692
3	Uses shared toilet with neighbours							
	No	130 (21.5%)	475 (78.5%)					
	Yes	25 (18.8%)	108 (81.2%)					
	Total	155 (21.0%)	583 (79.0%)	1.182	(0.734-1.904)	0.476	1	0.490/0.557
4	Type of residential facility							
	Rented	19 (20.7%)	73 (79.3%)					
	Owned by parent/ guardian	135 (20.7%)	517 (79.3%0					
	Total	154 (20.7%)	590 (79.3%)	0.997	(0.581-1.709)	0	1	0.991/1.000
5	Method of refuse disposal							
	Dumping	134 (22.8%)	453 (77.2%)	3.423	(1.544-7.586)			
	Dumping and Burning or burying	7 (8.0%)	81 (92.0%)	-				
	Refuse collection	12 (17.9%)	55 (82.1%)	1.890	(1.130-3.162)			
	Total	153 (20.6%)	589 (79.4%)			10.673	2	0.005*
6	Source of drinking water							
	Stream/river	8 (13.3%)	52 (86.7%)	0.730	(0.332-1.608)			

	Well	29 (26.9%)	79 (73.1%)	1.742	(1.056-2.874)			
	Water vendors/Truck pushers/Tanks	51 (26.6%)	141 (73.4%)	1.717	(1.134-2.599)			
	Pipe borne water	67 (17.4%)	318 (82.6%)	-				
	Total	155 (20.8%)	590 (79.2%)			10.997	3	0.012*
7	Environment has drainage/ not water-logged							
	No	73 (19.0%)	311 (81.0%)					
	Yes	82 (22.7%)	279 (77.3%)					
	Total	155 (20.8%)	590 (79.2%)	0.799	(0.560 - 1.138)	1.550	1	0.213
8	Type of residential housing material							
	Cement/Brick	73 (18.4%)	324 (81.6%)					
	Mud, cornstalk etc	82 (23.6%)	266 (76.4%)					
	Total	155 (20.8%)	590 (79.2%)	0.799	(0.513-1.042)	3.014	1	0.083

Table 4 Association between malnutrition (Stunting) and WASH Indicators

SN	**Variable/ Category**	**Malnutrition (Stunting)**		**OR**	**CI**	**Chi Sq**	**df**	**P-Value**
		Yes (< -2)	No (-2+)					
		n (%)	n (%)					
1	Availability of toilet in residence							
	No	34 (33.7%)	67 (66.3%)					
	Yes	133 (20.7%)	510 (79.3%)					
	Total	167 (22.4%)	577 (77.6%)	1.946	(1.235-3.066)	8.447	1	0.007*
2	Toilet being put to use							
	No	36 (33.6%)	71 (66.4%)					
	Yes	131 (20.6%)	506 (79.4%)					
	Total	167 (22.4%)	577 (77.6%)	1.958	(1.255-3.055)	9.003	1	0.004*
3	Uses shared toilet with neighbours							
	No	147 (24.3%)	458 (75.7%)					
	Yes	19 (14.3%)	114 (85.7%)					

	Total	166 (22.5%)	572 (77.5%)	1.926	(1.145-3.239)	6.269	1	0.012*
4	Type of residential facility							
	Rented	13 (14.1%)	79 (85.9%)					
	Owned by parent/ guardian	153 (23.5%)	499 (76.5%)					
	Total	166 (22.3%)	578 (77.7%)	0.537	(0.290-0.992)	4.054	1	0.045*
5	Method of refuse disposal							
	Dumping	144 (24.5%)	443 (75.5%)	2.786	(1.246-6.233)			
	Dumping and Burning or burying	15 (17.0%)	73 (83.0%)	1.761	(0.674-4.600)			
	Refuse collectors	7 (10.4%)	60 (89.6%)	-				
	Total	166 (22.4%)	576 (77.6%)			8.499	2	0.014*
6	Source of drinking water							
	Stream/river	19 (31.7%)	41 (68.3%)	2.561	(1.391-4.715)			
	Well	34 (31.5%)	74 (68.5%)	2.539	(1.553-4.151)			
	Water vendors/Truck pushers/Tanks	55 (28.6%)	137 (71.4%)	2.218	(1.460-3.370)			
	Pipe borne water	59 (15.3%)	326 (84.7%)	-				
	Total	167 (22.4%)	578 (77.6%)			23.473	3	0.000*
7	House environment has drainage or not water-logged							
	No	104 (27.1%)	280 (72.9%)					
	Yes	63 (17.5%)	298 (82.5%)	1.757	(1.235-2.500)	9.926	1	0.002*
	Total	167 (22.4%)	578 (77.6%)					
8	Type of residential housing material							
	Cement/Brick	73 (18.4%)	324 (81.6%)					
	Mud, cornstalk etc	94 (27.0%)	254 (73.0%)					
	Total	167 (22.4%)	578 (77.6%)	0.609	(0.430-0.861)	7.930	1	0.005*

4. Conclusion

This study concludes that negative WASH practices are associated with chronic malnutrition (stunting) and a combination of both chronic and acute malnutrition (underweight). Stunting was associated with all 8 WASH variables considered in this study, while underweight was associated with only 2 out of the 8 variables. The foregoing raises a germane concern about the role of WASH in malnutrition among school children and the need for a comprehensive and sustainable school feeding programme in the state and country at large. There is the need to also fully integrate WASH as a critical component of all nutrition intervention programmes.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

All the authors declare that they have no conflict of interest.

Statement of informed consent

Informed consent was first obtained from the parents of the participants via the parent teachers association and managements of the schools that took part in this study. Additionally, a verbal consent was secured from each of the volunteering pupils, with the option of pulling out of the survey at any point he or she feels not disposed to continue.

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