Nutritional status of children attending schools benefitting from UNICEF's assisted water, sanitation and hygiene programming in Ogun State, Nigeria

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Abstract

Background

There has been a growing interest in better understanding and measuring the effect of water, sanitation and hygiene (WASH) on nutritional outcomes. In this study, we evaluated the nutritional status of children attending schools benefitting from UNICEF's assisted WASH programming in Ogun State, Southwest Nigeria

Methods

A total of 175 consenting school-aged children across three WASH programming schools participated in the study. The status and conditions of WASH resources were assessed and graded using standardized tools. Anthropometric measures of weight, height and age were obtained and compared with reference data to assess stunting, underweight and thinness. Descriptive and logistic regression analysis were performed to estimate magnitude of association between dependent (malnutrition indices) and independent (demographic and WASH) variables. Significant difference was set at 95%.

Results

WASH scores ranged between 62.5-81.3% across the three schools; School A (68.8%), B (81.1%) and C (62.5%). Optimal scores were recorded for water (100%) and hygiene (60-80%) resources, however sanitation scores (33.3-66.7%) were poor. Overall proportion of stunting, underweight and thinness were 24.0%, 11.3%, and 38.9% respectively. The odds of stunting (5.98, 95% CI: 5.01-6.94) and thinness (5.44, 95% CI: 4.26-6.61) was higher among children above age 11 ($p < 0.05$). Similarly, odds of stunting were high in school B (40.91, 95% CI: 38.7-43.0) and C (28.91, 95% CI: 26.7-31.0). However, thinness was less likely in schools B (0.003, 95% CI: -1.83-1.84) and C (0.014: 95% CI: -1.68-1.71) ($p < 0.001$). Schools accounted for 10.7% variation in underweight, while the combination of age and school accounted for 23.3% of the variation in stunting, and 47.8% of the variation in thinness.

Conclusion

Regardless of WASH programming status, malnutrition indices were significantly influenced by a combination of school clustering and age of children. Our findings support the multicausality model for malnutrition. It is therefore important to complementing existing WASH programming efforts, with additional nutritional program such as provision of free, safe and nutritious food to school children.

Background

Malnutrition remains a global public health problem, with predominance in low- and middle-income countries, especially areas where poverty, inadequate access to healthcare and basic infrastructural facilities persists [1]. The term “*malnutrition*” has been used to describe all forms of nutrition disorders caused by a complex array of factors, including deficiencies, excesses or imbalances in nutrients intake and other diet-related non-communicable diseases [1, 2]. In 2020, about 149 million of these children were estimated to be too short for their age (stunting), 45 million adjudged to be too thin for their height (wasted) and 38.9 million were overweight [1]. About two-third of these nutritional outcomes originates from Sub-Saharan Africa, with majority of these outcomes recorded among immunocompromised children under age 5 [1, 3].

Nutritional deficiencies during a child's development have long-term adverse consequences on cognition, social abilities, school performance, and work productivity as they grow into adults, and in rare situations may lead to disorders or death [1, 3, 4]. More importantly, malnourished girls are likely to become malnourished mothers, with higher odds of giving birth to low-birth-weight infants, who are more likely to die or become stunted [3]. The causes of malnutrition are multifactorial, with the condition mostly influenced by factors such as poor diet, inadequate access to healthcare and basic sanitation facilities [3]. Optimal nutritional status can therefore be achieved when there is access to safe, nutritious and sufficient food, in addition to appropriate maternal and child health practices, adequate health care service and healthy environment including safe water, sanitation and good hygiene (WASH) [3].

Pathogens that are transmissible via the faecal-oral pathway, more specifically, those causing diarrhea, intestinal parasitic infections and environmental enteropathy are known to directly impair nutritional status through loss of appetite, malabsorption of nutrients, increased metabolism, and anemia [3, 5–10]. These pathogens thrive in areas where WASH facilities are lacking or inadequate. As such, investments in provision of adequate and accessible WASH interventions can interrupt their transmission, with sanitation facilities preventing pathogens from reaching the soil or water sources, and improved water sources, preventing the usage of contaminated water bodies, and also promoting positive hygiene practices [11].

Over the last decade, several governmental and non-governmental organizations, for instance UNICEF, had invested in implementation of WASH resource programming, with the primary aim of providing, and improving access to safe water supply, improved sanitation and good hygiene practices in rural and marginalized settings [12]. When WASH resources are appropriately implemented and maintained, there is considerable evidence that they have the potential to reduce transmission of fecal-oral pathogens, and indirectly improve children's nutritional status [3]. However, there are less evidence on the direct link between WASH and improved nutritional status [3, 13, 14], when compared with WASH on incidence of diarrhea [15–17] or intestinal parasitic infections [11, 18, 19]. This gap in knowledge, has increased the interest in better understanding and measuring the effect of WASH on nutritional outcomes [3], this study therefore investigated the effect of WASH on nutritional status, by leveraging on children attending schools benefitting from UNICEF's assisted WASH programming in Ogun State, Southwest Nigeria

Methods

Study area

This study was conducted at Odeda local government area (LGA) in Ogun State, Nigeria. The LGA is one of the 20 administrative districts in the state, and is located within longitude 2°45'00 "E and 3°55'00 "E and latitude 7°01'00 "N and 7°18'00 "N. There were 106 government owned schools in the area which comprises of both urban and rural settlements. The LGA was purposively selected for the study, because it is the pilot site for UNICEF' assisted WASH programming [20]. Of the 106 schools, only 3 schools were benefitting from the WASH programming as at the time of the study; (1) OLG primary school, Alabata, (2) Baptist day primary school, Obete and (3) Saint Saviours' primary school, Olugbo [11,20]. These schools were provided with water pumps, sanitation facilities and in some instances hand-washing facilities as compared to other schools within the LGA.

Study design, population and sample size estimation

This study is cross-sectional in design, and involved the use of standardized questionnaires to assess the status and condition of WASH facilities across the recruited schools. In each school, a total of 60 pupils above 6 years of age were targeted for recruitment i.e., an average of 10 pupils per class from grade 1 to 6. However, based on the population of each class grade, a proportional quota was used in recruiting pupils.

Ethical approvals and recruitment of study participants

Ethical approval for the study was obtained from the Department of Public Health and Disease Control, Ogun State Ministry of Health. Field permits were also obtained from three other establishments; (1) Ogun State Ministry of Education, Science, and Technology, (2) Ogun State Rural Water Supply and Sanitation Agency (RUWATSAN), and (3) Zonal Education Officer of Odeda LGA. Headmaster of each school were approached and authorization to conduct the study were received. Parents were informed about the study via parent-teacher-association (PTA) meeting. Children who were above 6 years of age, and whose parents consented to their participation through a signed informed consent form, were invited to participate in the study. Children's assent was obtained verbally and also documented through an assent form in the presence of the class teacher.

Data collection

Demographic data including name, date of birth, and sex of the children were obtained by experienced scientists and fieldworkers using well-structured questionnaire. Anthropometric data such as weight, height, and age were also collected. The ages of the children were later cross-referenced against information available from the school registers for validity. Weight was measured in kilograms (kg) using a domestic standardized Hanson's bathroom weighing scale, while height (cm) was measured using the common builder's measuring tape. Data were entered into the participants' form by two different observers and compared for consistencies. Another team of researchers collected data on the status and

conditions of WASH in the school. A standardized field form was used to document type of water supply, number of water source, condition and type of latrines, number of latrines and availability of soaps in toilets. WASH conditions that met the standards set out by WHO [21] were scored one point, and those not meeting the set standards were scored zero. A cumulative score was computed for each component of WASH resource, and overall score was computed for each school.

Anthropometric/Nutritional analysis

Nutritional analysis was carried out for stunting (Height-for-Age (HAZ)), underweight (Weight-for-Age (WAZ)) and thinness (BMI-for-Height (BMZ)) according to World Health Organization Child Growth Standard using the WHO Reference 2007 SPSS macro package (2008) [22]. Children whose HAZ, WAZ and BMZ were above -2SD scores were considered normal and those below -2SD and -3SD scores were considered malnourished and severely malnourished respectively [23,24]. Anthropometric analysis for WAZ was calculated only for children ≤ 10 years of age who are yet to reach puberty stage [25]. Z-scores were used to compare the children across the schools to the WHO reference population. Z scores were assigned as “missing” to children with missing WAZ (n=12), BMZ (n=12), HAZ age (n=3) and omitted in subsequent statistical analysis.

Statistical analyses

All statistical analysis were performed using IBM SPSS 20.0 version, Armonk, NY, IBM Corp. Data were first subjected to descriptive statistics including frequencies and cross-tabulations, and subsequently to Pearson chi-square analysis to test for variables (sex, age and school types) that were significantly associated with malnutrition indices (stunting, underweight and thinness). Variables showing significant relationship (p -value < 0.05) with any of the malnutrition indices were selected as potential predictive factors for malnutrition and entered into the logistic regression model as covariates using bidirectional stepwise entry method. Reference category was formulated for categorical variables before analysis, excluding observations with missing values for any variable. Predictive index in the model is represented as $\text{Exp}(B)$ or Odds Ratio (OR). Significant level was set at 95%.

Results

Demographic characteristics of the study population

A total of 175 school-aged children participated in this with 64(36.6%) from School B, 55(31.4%) from School A and 56 (32.0%) from School C. By age categories, majority 104(59.4%) were in the 11-15years category and 71(40.6%) belonged to the 6-10 years category. There were also more males 94(53.7%) than females, 81(46.3%) (Table 1).

Table 1
Demographic characteristic of study population

Variable	No. of Respondents (%), <i>N</i> = 175
<i>Age (in years)</i>	
6 – 10	71 (40.6)
11 – 15	104 (59.4)
<i>Sex</i>	
Male	94 (53.7)
Female	81 (46.3)
<i>School</i>	
School A (OLG, Alabata)	55 (31.4)
School B (Baptist Day, Obete)	64 (36.6)
School C (St. Saviours, Olugbo)	56 (32.0)

Status And Condition Of Wash Resource In Surveyed Schools

A total of 16 WASH related conditions were assessed in each study school. WASH scores ranged between 62.5-81.1% across the three schools with School A having a cumulative score of 11(68.8%) and schools B and C with a score of 13(81.1%) and 10(62.5%) respectively. School B had the most improved WASH score, followed by A and C. Optimal scores were recorded for water (100%) and hygiene (60-80%) resources, however sanitation scores (33.3-66.7%) were poor (Table 2).

Table 2
Status of WASH resources across the surveyed schools

	School A		School B		School C	
	Condition	Score (%)	Condition	Score (%)	Condition	Score (%)
Water Resource (n=5)						
Type of water source	Hand pump borehole	1.0	Hand pump borehole	1.0	Hand pump borehole	1.0
Number of water source	One	1.0	One	1.0	One	1.0
Condition of water source	Functioning	1.0	Functioning	1.0	Functioning	1.0
Frequency of water supply	Daily	1.0	Daily	1.0	Daily	1.0
Distance of water source	<30 meters	1.0	<30 meters	1.0	<30 meters	1.0
		5 (100)		5 (100)		5 (100)
Sanitation Resource (n=6)						
Toilet type	Sanplat latrine	1.0	Sanplat latrine	1.0	Pit with Lid	1.0
Condition of toilet	Dirty	0.0	Dirty	0.0	Dirty	0.0
Soaps in toilet	None	0.0	None	0.0	None	0.0
Toilets per pupil's population	212:1	0.0	23:1	1.0	148:1	0.0
Toilets per gender	None	0.0	Yes	1.0	None	0.0
Presence of urinal facilities	Yes	1.0	Yes	1.0	Yes	1.0
		2 (33.3)		4 (66.7)		2 (33.3)
Hygiene Resource (n=5)						
Presence of bushes	No	1.0	Yes	1.0	No	0.0
Presence of garbage can	Yes	1.0	Yes	1.0	Yes	1.0
Presence of drinking water bucket with tap	No	0.0	No	0.0	No	0.0
*Scoring criteria: 0, if the condition of WASH resource is bad/Non-improved/ Inadequate; 1, if the condition of WASH resource is good/improved/adequate						
**School A: OLG, Alabata; School B: Baptist Day, Obete; School C: St. Saviours' Olugbo						

	School A		School B		School C	
Presence of hand washing facilities	Yes	1.0	Yes	1.0	Yes	1.0
Presence of authorized food vendors	Yes	1.0	Yes	1.0	Yes	1.0
		4 (80.0)		4 (80.0)		3 (60.0)
Cumulative score		11 (68.8)		13 (81.3)		10 (62.5)
*Scoring criteria: 0, if the condition of WASH resource is bad/Non-improved/ Inadequate; 1, if the condition of WASH resource is good/improved/adequate						
**School A: OLG, Alabata; School B: Baptist Day, Obete; School C: St. Saviours' Olugbo						

Nutritional Status Of Surveyed Children

The overall prevalence of stunting, underweight and thinness was 24.0%, 11.3% and 38.0% respectively. However, prevalence of severe stunting, underweight and thinness was 6.9%, 2.9% and 22.3% respectively. Stunting (33.7%) and thinness (50.0%) was higher in children aged 11-15 years compared to children aged 6-10 years (10.3% and 29.2% respectively). These nutritional indices had a significant relationship with age ($p < 0.001$ for stunting and $p = 0.008$ for thinness). Furthermore, stunting, underweight, and thinness were all significantly associated with school ($p < 0.001$ for stunting, $p = 0.013$ for underweight, and $p < 0.001$ for thinness), with higher prevalence of stunting in School B (36.5%), underweight in School C (28.6%) and thinness in School A (95.7%). There was no significant relationship between sex and any of the nutritional indices, albeit men had a slightly higher prevalence of stunting (27.2%), underweight (15.2%), and thinness (42.5%) than females (Table 3).

Table 3
Malnutrition status among surveyed children

	Number examined	Height-for-age (stunting)	Weight-for-age* (Underweight)	BMI-for-age (Thinness)
Malnutrition category				
Acute (Z-score less than -2SD)	175	42 (24.0)	8 (11.3)	68 (38.9)
Severe (Z-score less than -3SD)	175	12(6.9)	2(2.9)	39(22.3)
Overall malnutrition	175	42 (24.0)	8 (11.3)	68 (38.9)
Age range (years)				
6 – 10	71	7 (10.3%)	8 (100.0%)	19 (29.2%)
11 – 15	104	35 (33.7%)	0(0)	49 (50.0%)
p-value		< 0.001**		0.008**
Sex				
Male	94	25 (27.2%)	5 (15.2%)	37 (42.5%)
Female	81	17 (21.2%)	3 (8.1%)	31 (40.8%)
p-value		0.37	0.36	0.820
School				
School A	55	1 (1.9%)	1 (4.8%)	44 (95.7%)
School B	64	23 (36.5%)	1 (3.6%)	6 (9.8%)
School C	56	18 (32.1%)	6 (28.6%)	18 (32.1%)
p-value		< 0.001**	0.013**	< 0.001**
*Weight-for-age is calculated for children ≤ 10 years, with N=71 [25]				
**P-value < 0.05 shows significant relationship between variables by Pearson chi-square test of association				

Logistic regression model between nutritional status, age and school types

Except for underweight, all relevant covariates (age and school types) were significant predictors of malnutrition in the models. In the absence of predictive indicators, the intercept model indicated that children were less likely to be experience stunting (OR:0.32), underweight (OR:0.13) and thinness (OR:0.72). However, R^2 analysis revealed that clustering in schools accounted for 10.7% of the variation

in underweight, while the combination of age and school accounted for 23.3% of the variation in stunting, and 47.8% of the variation in thinness. In children aged 11-15 years, the risk of (5.98, 95% CI: 5.01-6.94) and thinness (5.44, 95% CI: 4.26-6.61) were six times higher when compared to children aged 6-10 years. The odds of stunting were the highest in school B (40.91, 95% CI: 38.7-43.0), irrespective of the high WASH score, followed by school C (28.91, 95% CI: 26.7-31.0), when compared to School A. However, thinness was less likely in schools B (0.003, 95% CI: -1.83-1.84) and C (0.014: 95% CI: -1.68-1.71) when compared to school A ($p < 0.001$) (Table 4).

Table 4
Logistic regression model between nutritional status, age and school types

	Height-for-age (Stunting)		Weight-for-age (Underweight)		BMI-for-age (Thinness)	
	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>P</i> -value
Intercept Model	0.32	<0.001*	0.13	<0.001*	0.72	0.035*
Age range (years)						
6 – 10	1	-			1	-
11 – 15	5.98 (5.01-6.94)	<0.001*	-	-	5.44(4.26-6.61)	0.004*
School						
School A	1	-	1	-	1	-
School B	40.91(38.7-43.0)	< 0.001*	0.74(-3.27-4.75)	0.84	0.003(-1.83-1.84)	< 0.001*
School C	28.91(26.7-31.0)	0.001*	8.00(4.85-11.14)	0.07	0.014(-1.68-1.71)	< 0.001*
Cox and Snell R²	0.233		0.107		0.478	
* <i>p</i> -value < 0.05 indicates significant coefficients determined by multinomial regression analysis; OR: Odd ratios; CI: Confidence Interval						

Discussion

There are plethora of published articles highlighting the malnutrition problem among children in Nigeria, with recommendations made towards provision of improved nutritional programs [26–32]. The home school feeding program was instituted to respond to the malnutrition problems in rural and marginalized settings, with the primary aim of providing safe, and nutritious meal to children during school hours at no cost [26, 32]. This program is yet to be implemented in Ogun State as at the time of this study [26]. It has

also been advocated that provision of improved WASH resources have indirect linkages with improved nutritional status, but there is paucity of evidence in this regard [3]. It is therefore important to understand how WASH impacts nutritional outcome, with the view of complementing existing recommendations targeted at improving children's nutrition. Randomized control trials are the most appropriate designs for evaluating such effects, however such designs are expensive, time consuming, and would require cross-sectoral collaborations. This study therefore leveraged on children attending schools benefitting from UNICEF's WASH resource programming. We hypothesized that malnutrition should be less pronounced among these population considering their additional access to WASH resources in the schools. We observed an overall prevalence of 24% for stunting, 11.3% for underweight and 38.9% for thinness, which were notably lower than those reported in Ibadan (44% stunting, 40% underweight) [29] and Kaduna (41.2% stunting, 48.7% underweight) [30] among children between age 5 and 15. However, our observation are higher than those reported in Sagamu, Ogun state (14.2% stunting, 25.5% underweight, 22.2% thinness) among children within the same age category, and were not attending schools with access to WASH services [31]. These disparities in nutritional status therefore reiterates the dynamic and multifactorial causality of malnutrition, which changes with space and time [33].

Furthermore, we observed disparities in nutritional status even among schools, despite the fact that the all the children had access to improved WASH services. Alas, children in school B with the best WASH conditions have odds of been stunted when compared to other schools with lower WASH conditions. The first 1000 days of a child's life are the most important for stunting [34]. In Nigeria, and presumably elsewhere, children spend these first days in the households with their mothers under their care and attention, and usually proceeds to school for primary education after age 2. If a child is stunted by age two probably as a result of diarrhea, heavy worm infections, or environmental enteropathy [3], subsequent catch-up growth is minimal, and it is more or less impossible to achieve normal growth [35]. As such having access to improved WASH resources in schools may likely not have positive impacts on reversing stunting after age 2. It is therefore impracticable to attribute stunting to availability and conditions of WASH resources, since stunting is a manifestation of long-term malnutrition [36]. On the other hand, there were no measures to ascertain level of usage of WASH resources among these populations. Children after school hours, spend more time at home, engaging in house-chores and other non-educational activities which requires mobility and may reverse the health gains conferred by using WASH services in schools. This observation is in line with our findings which established that children above age 10 have higher odds of becoming malnourished. This has also been reported elsewhere in Kenya [37] and Bangladesh [38]. Children above age 10 belongs to the upper-class grades (grades 4, 5 or 6) and are generally more active and mobile than other lower age group. This mobility, increases their exposure to pathogens [39], which are likely to impact directly on their nutritional status [22]. This situation may be exacerbated for children who live in households where basic WASH facilities are lacking [11]. In addition, the likelihood of malnutrition increasing with age may also be explained by the intense supervisory habits of parents or teachers on the daily dietary intake of children below 10 years than the older ones [40]. Our findings therefore highlight the combined effects of age and school clustering on the malnutrition status of children. WASH interventions were less likely to act alone as a driver of malnutrition, and

complementary efforts targeted at improving daily dietary intake of the children should be prioritized. The introduction of school feeding programs in most public schools in Nigeria are designed to improve nutritional status [37, 38]. In areas where they exist, these programs are subsidized by government to deliver free-of-charge foods to children in government owned schools [26]. However, in states where this program is not yet implemented and among non-governmental schools, children have to purchase food from vendors during lunch hours. These disparities in implementation may therefore contribute to the variation in malnutrition prevalence's observed across schools. It is therefore important that subsidized nutritional programs, aimed at providing safe, delicious and nutritious food to children are implemented across both governmental and non-governmental schools to complement ongoing WASH programming efforts.

Conclusion

Our study provides evidence that malnutrition status of school-aged children was significantly influenced by school clustering and age, irrespective of WASH programming status. Our findings support the multicausality model for malnutrition. Incorporation of free-school based feeding programs aimed at providing safe, nutritious and delicious meal to children as a complementary intervention to exiting WASH programming activities is important. Further studies disaggregating the effects of each WASH component is therefore necessary as we understand the relationship between WASH and nutritional status.

Limitations

Our study has several limitations, firstly, rather than conducting a randomized control trial, we designed an observational study among purposively selected schools, benefitting from UNICEF's assisted WASH programming. Hence, this may present a limitation in the generalizability of our results. Secondly, we didn't collect household WASH related data, daily dietary intake and other socio-economic data which might have been useful as important covariates in understanding the effects of WASH and nutritional status. Thirdly, our WASH assessment protocol was not robust enough to allow disaggregation assessments of individual WASH components, for measuring individual effects on nutritional status.

Abbreviations

BMZ
Body Mass Index for Age
CI
Confidence Interval
HAZ
Height for Age
LGAs
Local Government Areas

OR
Odds Ratio
SPSS
Statistical Package for Social Sciences
UNICEF
United Children's Emergency Fund
WASH
Water Sanitation and Hygiene
WAZ
Weight for Age
WHO
World Health Organization

Declarations

Ethical approvals and consent to participate

Ethical approval for the study was obtained from the Department of Public Health and Disease Control, Ogun State Ministry of Health. Field permits were also obtained from three other establishments; (1) Ogun State Ministry of Education, Science, and Technology, (2) Ogun State Rural Water Supply and Sanitation Agency (RUWATSAN), and (3) Zonal Education Officer of Odeda LGA. Headmaster of each school were approached and authorization to conduct the study were received. Parents were informed about the study via parent-teacher-association (PTA) meeting. Children who were above 6 years of age, and whose parents consented to their participation through a signed informed consent form, were invited to participate in the study. Children's assent was obtained verbally and also documented through an assent form in the presence of the class teacher. The study procedures were carried out in accordance with established rules and standards as documented in the 1964 Declaration of Helsinki for human studies.

Consent for publication

The authors give consents to publication

Availability of data and materials

The datasets used and/or analyzed during the current study have been attached as supplementary file.

Competing interests

The authors declare that they have no competing interest

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Authors' contribution

HOM conceptualized the study, and prepared the protocol, while UFE, DOA improved the protocol. HOM, OOO, ASB, ONA, SNO participated in field surveys and data collection. OOO and HOM performed all nutritional and statistical analysis. HOM prepared the first draft of the manuscript. HOM, OOO, CAY, ASB, ONA, SNO, DOA, UFE contributed to the development of the final manuscript and approved its submission.

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