International Journal of Clinical Nutrition, 2016, Vol. 4, No. 1, 7-11
Available online at http://pubs.sciepub.com/ijcn/4/1/2

DOI:10.12691/ijcn-4-1-2

Assessment of Childhood Nutritional Status: Findings from a Health and Demographic Surveillance System

Adeola Alabi[1], Macellina Yinyinade Ijadunola[1], Olatunji Alabi[2,*], Adedeji Onayade[1], Olufemi Aluko[1]

[1]Department of Community Health, Obafemi Awolowo University, Ile-Ife, Nigeria
[2]Department of Demography and Social Statistics, Federal University, Birnin Kebbi, Kebbi State, Nigeria
*Corresponding author: yomistorii@yahoo.com

Abstract **Background:** Globally, malnutrition is a major public health concern. Malnutrition, mostly resulting from poor dietary choices is related to physiological, socioeconomic and psychological factors and remains one of the leading causes of under-five mortality (U5M) in developing countries. Interventions aimed at addressing the high prevalence of malnutrition in most developing countries is hampered by paucity of data on its prevalence and thus, most countries do not accord malnutrition especially among children under-five (under-5) years the required urgent attention. The study therefore assessed the nutritional status of under-five children in Zamfara State, northwest Nigeria. **Methods:** Households with children under-5 registered within the Nahuche Health and Demographic Surveillance System (Nahuche HDSS) were identified from the centre's database. Nutritional status of 397 children under-5 were assessed from three out of the six districts under the demographic surveillance area (DSA) using anthropometric indices. The anthropometric measurements (z-scores) were calculated for height-for-age (HAZ), weight-for-height (WHZ) and weight-for-age (WAZ) using the Emergency Nutrition Assessment (ENA) for SMART Software. The nutritional status of children under-5 in the DSA was compared with new growth standards published by World Health Organisation (WHO) in 2006. **Results***:* Results show that malnutrition was prevalent, with 70% (n=397) of the under-5 stunted, 15% (n=292) wasted and 37% (n=397) underweight. About half of the stunted children, were severely stunted while almost a quarter (23.9%) of the underweight children, were severely underweight. **Conclusion**: The study provided evidence of high malnutrition among under-five children in the study area and thus, emphasized the need for multidimensional and multisectoral intervention aimed at addressing prevalence of high malnutrition. This can be achieved through strategic advocacy to policy level stakeholders, promotion of maternal and child health (MCH) services and integrated health promotion focusing on caregivers of children under-5.

Keywords: *nutritional status, under-5, maternal and child health, malnutrition, demographic surveillance, INDEPTH Network, Nigeria*

Cite This Article: Adeola Alabi, Macellina Yinyinade Ijadunola, Olatunji Alabi, Adedeji Onayade, and Olufemi Aluko, "Assessment of Childhood Nutritional Status: Findings from a Health and Demographic Surveillance System." *International Journal of Clinical Nutrition*, vol. 4, no. 1 (2016): 7-11. doi: 10.12691/ijcn-4-1-2.

1. Introduction

Malnutrition is a major Public Health challenge in Nigeria, especially as it affects the health of children under-5. Malnutrition is a pathologic state consequent of relative or absolute insufficiency or excess of one or more essential nutrients sufficient to produce disease [1]. Malnutrition is one of the leading causes of U5M in developing countries though, the severity and various dimensions of the situation has been poorly researched and documented in Nigeria. More than 10 million under-5 children die annually worldwide and malnutrition accounts for about 60% of these deaths [2,3,4]. There were reported cases of child malnutrition in developing countries like Haiti, Sierra Leone, Egypt, Tanzania, China- where more than one quarter of all children under-5 are underweight, many to a life-threatening degree [5]. Childhood malnutrition has received little attention relative to the magnitude of the problem [5].

Although Nigeria recorded a decline in under-5 stunting from 41% in 2008 to 37% in 2013 [6], Nigeria still accounted for 11 million out of the world 60 million stunted children in the year 2012 [7]. Nigeria demographic and health survey [6] showed that the trend in nutritional status worsened from 24% in 2003 to 23% in 2008 and 29% in 2013 for underweight and 11% in 2003 to 14% in 2008 and 18% in 2013 for wasting. Generally, practice of exclusive breastfeeding which could help improve the under-5 nutritional status remains very low among child bearing women in Nigeria. For instance, only 17% of children under the age of six months are exclusively breastfed in Nigeria [6] - a situation that has remained unchanged over the past 5 years.

Evidence suggests that malnutrition is prevalent in Nigeria in general and northwest Nigeria in particular−where basic essential needs of life; food, shelter and clothing−are often not within the reach of the majority poor. More than half of the under-5 children from the region were chronically malnourished (below -2 SD)

while 36% were severely stunted (below -3 SD) [6]. Zamfara State is one of the States in the region with appalling malnutrition among under-5 children. For example, 34% of the children were severely malnourished while 56% were chronically malnourished [6].

A number of studies have documented the importance of adequate intake of nutrients in the first 0-59 months of life [8,9,10,11]. Various interventions aimed at improving the nutritional status of Nigerian children by various stakeholders are ongoing. For example, some state government embarked on school feeding programmes in primary schools with the ultimate goal of improving the nutritional status of primary school pupils while, health promotion and nutritional information are being disseminated to address under-5 malnutrition. Some of the interventions provided nutritional packs i.e. "Ready to Use Therapeutic Food" (RUTF) as well as provision of health care services for severely malnourished children. Despite the investments, improvement in under-5 nutritional status is hampered by lack of reliable data on the prevalence of malnutrition to inform evidence-based intervention, coupled with unrest in northern Nigeria with displacement of people especially children who are currently domiciled in internally displaced camps where facilities and services are poorly provided.

This study provided community based prevalence of under-5 malnutrition compared to the facility based prevalence reported by Ebiloma [12]. The study was motivated by: the lack of baseline estimates of the prevalence of malnutrition in the study area against which success or otherwise of various interventions can be evidently measured in order to inform programme design and planning. Furthermore, it is hoped that the evidence from this study will draw attention to the scourge of under-5 malnutrition in the study area in particular and Northern Nigeria as a whole.

2. Methodology

2.1. Study Area

Nahuche HDSS attained membership of the International Network for the Demographic Evaluation of Populations and Their Heath (INDEPTH Network) in year 2012. The centre was established in 2009 with funding from the Department for International Development (DFID) and the Government of Norway through the Partnership for Reviving Routine Immunization in Nigeria; Maternal Newborn and Child Health (PRRINN-MNCH) funded Programme. The centre started as collaboration between PRRINN-MNCH and the Zamfara State government. The objective is to provide a platform for tracking longitudinally, changes in socio-demographic and health profile of a define population with a view to informing policies through evidence based findings from various social and health interventions[13].

Nahuche HDSS covers six districts of Gada and Karrakai (one political ward), Nahuche-Keku and Nahuche-Ubandawaki (One political ward) and; Rawayya and Bela (one political ward) in Bungudu Local Government area of Zamfara State. The districts are made up of rural population with subsistence farming as the main economic activity of the people. Social amenities are generally lacking and often substandard. The population of the DSA was over 140,000 individuals from over 21,000 households as at 2013. Operation at the centre began with a baseline census in 2010 and followed by bi-annual update data collection starting in January 2011. Detail of data collection and processing at Nahuche HDSS is documented elsewhere [13]. Verbal consent was obtained from parents of the selected children as well.

2.2. Sample Size Determination

Sample size of respondents for the survey was estimated using the computer programme for epidemiologist (PEP), version 3.01. Employing the sample size formula for estimation of proportions as described by Armitage and Berry and cited in [14] for population greater than 10000, the calculated sample size was 383 and was increased to 404 to allow for 5% non-response rate and to enhance robust analysis.

2.3. Sampling Technique

The sampling frame for the study was generated from the Nahuche HDSS database which had all members registered within the Demographic Surveillance Area (DSA). The HDSS platform offered a unique opportunity by having a unique identifier (permanent identification number (IDs)) for each member of the DSA starting with the household head in each household within the DSA. For instance, a woman in Gada district (which was one of the six districts making up the DSA), living in cluster "A", compound number one and household number one had a permanent ID of "GAA001001002". She was assigned line number "002" because her husband−who usually is the household head−was assigned line number "001".

Multistage sampling technique was used in the selection of the studied under-5 children. At the first stage, three districts were randomly selected out of the total six districts representing one district from each political ward. The three selected districts had a total of 48 clusters−Karakai (11), Nahuche-Keku (17) and Rawayya (20). Clusters are synonymous to enumeration area in a census. It is define as a demarcated area that can be conveniently covered by an enumerator during rounds. The second stage involved the selection of under-five children. The Nahuche HDSS database was used to generate a sampling frame of 11,436 under-five children in the three selected districts. Using a systematic sampling technique, a total of 404 under-five children were selected from the sampling frame. The sampling frame (11,436) was divided by the required sample size (404) to arrive at the K^{th} interval of 28. Every 28^{th} under-five child was selected from the sampling frame till the sample size was achieved.

2.4. Data Collection

Quantitative data collection was done with the aid of semi structured interviewer administered questionnaires. Content validity of the questions was ensured by translating to Hausa language and back-translating from Hausa language to English language. Hausa language speaking field workers were trained for data collection. The questionnaire comprised of three sections, A, B and C. Section A comprised of respondents' socio-demographic

information; Section B examined mothers' nutritional knowledge on breastfeeding initiation, duration of exclusive breastfeeding, health benefits in breastfeeding, timing of complementary feed, perception of certain foods; while section C asked questions about the child feeding practices (prelacteal feed, colostrum intake, breastfeeding initiation, average times of breastfeeding in 24 hours, current type of feed, and frequencies of classes of food intake). In addition, section C also comprised of anthropometric measurement (height and weight) of the index children were carried out.

2.5. Anthropometric Parameters and Scoring

Anthropometry is a technique that uses human body measurements to draw conclusion about the nutritional status of individuals and population and often applied to pre-school children below the age of 5 years. Anthropometric measurements were carried out using child's age, height and weight. Recumbent length (for children less than 24 months of age) and height (for children more than 24 months of age) were taken. Height and recumbent length was measured with United Nations Children Fund (UNICEF) standard wooden length board, sourced from the State UNICEF office and recorded to the nearest 0.1cm with both clothes and shoes off. Trained field workers measured weight to the nearest 0.01 Kg using a 'camry' weighing scale. All the instruments employed for the study were pretested using independent sample of twenty under-5 children prior to the study in order to ascertain the validity and reliability of the instruments.

These measurements were used in generating indices such as, height-for-age, weigh-for-age and weight-for-height. In order to ensure consistency and reduce error in taking the measurements during field work, each measurement was taken twice, and the mean of the two readings was recorded during training. If any pair of readings exceeded the maximum allowable difference for a given variable, the measurements were repeated. Participants were categorized using the indices that were compared with standard reference values of World Health Organization (WHO) standards recommendations to obtain the *Z*-scores.

Children with height-for-age *Z*-score of below minus 2 and below minus 3 standard deviation from the median of the reference population were considered stunted and severely stunted while, children with weight-for-age *Z*-score less than minus 2 and less than minus 3 standard deviation from the median of the reference population were regarded as underweight and severely underweight. Lastly, children with Weight-for-height *Z*-score less than minus 2 and minus 3 standard deviation from the median of the reference population were classified as wasted and severely wasted.

2.6. Analysis

Data entry was done using EpiData version 3.1 software. The data was later exported to the Emergency Nutrition Assessment (ENA) for SMART software to calculate height-for-age (HAZ), weight-for-height (WHZ) and weight-for-age (WAZ) for the anthropometric analysis (z-scores). Three indices of malnutrition (stunting, wasting and underweight) determined as an effect of poor child feeding practices was calculated using new growth standards published by WHO in 2006 which can be used to assess children all over the world, regardless of ethnicity, social and economic influences, and the feeding practices.

3. Results

Data of 397 under-5 children were analysed out of the 404 targeted for the study. Thus, a response rate of 98% was recorded during the study. There were more females than males (51.4% and 48.6% respectively). More than half of the under-5 children weighed between 2.5-3.5kg at birth and majority (84.4%) were second or more birth order (Table 1).

Table 1. SOCIO-DEMOGRAPHIC CHARACTERISTICS OF INDEX CHILDREN

Socio-demographic characteristics	Frequency (n=397)	Percentage
Age (months)		
6-11	13	3.3
12-23	124	31.2
24-35	97	24.4
36-59	163	41.1
Child's gender		
Male	193	48.6
Female	204	51.4
Birth order		
First	62	15.6
Other	335	84.4
Birth type		
One	392	99.0
Twins	4	1.0
Birth weight (kg)		
< 2.5	131	33.3
2.5- 3.5	242	61.6
< 3.5	20	5.1
Total	**397**	**100.0**

Note: - Index Children Age (months) μ± SD 32 ± 15.

Table 2 and Table 3 showed the level of malnutrition in the surveillance area. Generally, 70% of the children were stunted while 54% were severely stunted. Stunting is apparent and high even among children less than 12 months of age (85%). It was shown that stunting decreases with increase in the age of the child through the first five years of life. Male children (72% and 68%) are more likely to be stunted than females. Furthermore, males were severely stunted than female children (57% and 52%). A negative mean Z-score (SD) of -3.27 was computed and showed that almost all the children suffer from under-nutrition. In terms of prevalence of wasting among the under-5 children, 15% of the under-5 in the study area were generally wasted. Wasting varies greatly by age and peaks among children age 36-59 months (18%). Female children were more likely to be wasted than their male counterparts (18% compared with 12%). In terms of severity of wasting by gender, females were more severely wasted than their male counterparts (14% and 10% respectively). A mean Z-score (SD) of 0.71 was computed for wasting.

Table 2. Height-for-Age, Weight-for-Height and Weight-for-Age of Index Children by background characteristics

Background Characteristics	Height-for-Age			Weight-for-Height			Weight-for-Age		
Age in months	**Severe Stunting**	**Moderate Stunting**	**Mean Z-score (SD)**	**Severe Wasting**	**Moderate wasting**	**Mean Z-score (SD)**	**Severe Underweight**	**Moderate Underweight**	**Mean Z-score (SD)**
6-11	10 (79.9)	1 (7.7)	-4.51	2 (15.4)	0 (0.0)	1.08	7 (53.8)	1 (7.7)	-2.45
12-23	79 (63.7)	10 (8.1)	-3.58	12 (9.8)	5 (4.9)	0.96	29 (23.0)	19 (15.1)	-1.5
24-35	51 (52.6)	20 (20.6)	-3.06	12 (11.3)	1 (0.9)	1.1	22 (22.2)	13 (13.9	-0.99
36-59	75 (46.0)	31 (19.0)	-3.06	22 (13.8)	6 (3.8)	0.24	38 (23.3)	19 (11.7)	-1.68
Child's Gender									
Male	109 (56.5)	30 (15.5)	-3.61	18 (9.5)	4 (2.1)	0.76	43 (22.3)	27 (14.0)	-1.59
Female	106 (52.0)	32 (15.6)	-2.95	29 (14.4)	8 (3.9)	0.66	52 (25.5)	25 (12.2)	-1.38
All	215 (54.2)	62 (15.6)	-3.27	47 (12.0)	12 (3.1)	0.71	95 (23.9)	52 (13.1)	-1.48

Note: Absolute figures for wasting does not add up to 397 due to flagging (outliers) figures.

Table 3. Prevalence of Stunting, Wasting and Underweight by sex

Nutritional Status	Boy n=193 F (%)	Girls n=204 F (%)	Total N=397 F (%)	Statistical indices
Stunting				
Severe stunting	109 (56.5%)	106 (52.0%)	215 (54.2%)	$\chi^2 = 1.0024$
Moderate stunting	30 (15.5%)	32 (15.6%)	62 (15.6%)	p-value=0.606
Normal	54 (28.0%)	66 (32.4%)	120 (30.2%)	df = 2
Wasting				
Severe Wasting	18 (9.5%)	29 (14.4%)	47 (12.0%)	$\chi^2 = 3.4915$
Moderate wasting	4 (2.1%)	8 (4.0%)	12 (3.1%)	p-value=0.175
Normal	167 (88.4%)	165 (81.7)	332(84.9%)	df = 2
Underweight				
Severe underweight	43 (22.9%)	52 (25.5%)	95 (23.9%)	$\chi^2 = 0.6893$
Moderate underweight	27 (14.0%)	25(12.3%)	52 (13.1%)	p-value=0.708
Normal	123(63.7%)	127(62.3%)	250 (63.0%)	df = 2

Note: - Absolute figure for wasting does not add up to 397 due to flagging (outliers) figure.

Lastly, prevalence of under-weight among the under-5 children in the DSA was 37%. Among the underweight children, 24% were severally underweight. The nutritional indicator reported that male children are less likely to be underweight and severely underweight (36% and 22%) than female children (38% and 26%). The mean z-score of -1.48 computed for underweight showed that most if not all the children in the study sample suffer from underweight relative to the reference population. However, prevalence of malnutrition by gender was not statistically significant.

4. Discussion

The prevalence of malnutrition among under-5 children in the study area underscores the fact that child health issues in rural areas of northern Nigeria should be given urgent attention by government and other stakeholders.

Our study provides evidence-based data on prevalence of community malnutrition in a rural northern Nigerian setting and compliments some of the prevalence of malnutrition figures from other sources within Nigeria [6,15,16,17]. The finding from this study is indicative of the burden of high malnutrition prevalence in rural areas in Nigeria in general and rural northern Nigeria in particular where economic, cultural and traditional practices against adequate intake of necessary nutrients in the first five years of life are still dominant. For instance, comparing the figures for the three measures of malnutrition from the study with the nationally representative data of Nigeria Health and Demographic Survey [6], showed a similar trend of high malnutrition prevalence for Zamfara State. The prevalence of stunting from the study was 70% compared to State's average of 89% from the NDHS [6]. In the same vein, prevalence of wasting from the study was 15% compared to 22% from the NDHS while prevalence of underweight from the study was 37% compared to 53% from the NDHS [6].

Furthermore, continued awareness creation and strategic campaign by government at all levels on the need to practice exclusive breastfeeding by mothers will help to reduce the prevalence of malnutrition among the newborns. Practices in the study area discouraging the practice of exclusive breastfeeding should be discouraged. Some of the children were given local drinks (concoction) and water immediately after birth. It is believed that such local "concoction" makes a child strong but the harmful effect of this on child's health is usually ignored. "Tradition" and "culture" was most reported as reason for not giving colostrums to newborns. There is a misconception that colostrums is harmful to child's health as it is usually "dirty".

The study has two key limitations. Firstly, the study area is in one LGA out of 14 LGAs in Zamfara State and the finding is from surveillance area covering only 3

political wards within the LGA. To this end, generalization of our result to other rural areas should be done with caution.

Secondly, response and recall biases may not be totally eliminated in a cross-sectional study. The generalization of this study should be done with caution as only few nutrition indicators were selected to measure feeding practices. Additionally, there may be some unmeasured confounders such as- household hygiene variations, presence of food contaminants, and availability of home-grown food and clean water -that probably had some influence on the results. The birth weight of some under-5 was subjectively determined since there were no official records because of high percentage of home delivery in the study area.

5. Conclusion

The finding from this study suggests that the under-5 children in the study area require nutritional intervention. Efforts at reorienting caregivers and parents on the importance of nutritional security and adequate nutrient intake especially during the first five years of life will probably have great impact in reducing the prevalence of under-5 malnutrition.

Finally, strengthening the research capacity of the Nahuche HDSS to generate timely and evidenced based data to inform the right policy should be taken with high sense of priority as such HDSS platform can be used to assess the impact of such interventions after some years of intervention.

Conflict of Interest

The authors declare that there were no conflicts of interests.

Acknowledgement

PRRINN-MNCH programme is acknowledged for the support received during the conduct of this study. Also acknowledged are the leadership of Zamfara State Government through the State Ministry of Health, and the chairman of Bungudu LGA. The field enumerators that worked during data collection of this study are duly acknowledged as well as the Nahuche HDSS supervisors, interviewers as well as the data entry staff and all the staff in various capacities. Lastly and most importantly, the six district heads, community leaders as well as the respondents who took part in the survey are appreciated for their support and time to respond to all the questions.

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