IFPRI Discussion Paper 01776

December 2018

Child Nutritional Status, Welfare and Health in Nigerian Households

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ABSTRACT

The study attempts to provide insights into the relationships among child nutritional status, welfare and health among households and how these have evolved in Nigeria using the 2003, 2008, and 2013 children recode data of the Demographic and Health Survey (DHS) for Nigeria. We proxy welfare by using the wealth index of the DHS that captures wealth over time. Descriptive statistics and multilevel mixed-effects probit analysis were used to ascertain the linkages among child nutritional status, wealth, and health. The descriptive results show that malnutrition among under-5 children varies across the different wealth index levels with 50% and 35% of the children under-5 in the bottom two quintiles of the wealth index stunted and underweight, respectively. Results of the mixed-effects probit model also show that a child from a household with lower welfare is more likely to be malnourished. Our results also show that between 2003 and 2013, there has been no significant change in the wealth index levels between the richest and the poorest households. The study concludes that a household welfare level that is above average motivates increased nutritional levels among women and children in households and reduces the incidence of disease. Policies and practices that would increase the welfare of households would also have impacts on the nutritional status of households, especially those in the northern parts of Nigeria.

Keywords: Household welfare, child nutritional levels, incidence of disease, mixed-effects probit models, Nigeria, Demographic and Health Survey.

ACKNOWLEDGMENTS

This paper has been prepared as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by the International Food Policy Research Institute (IFPRI). Any opinions expressed here belong to the authors and do not reflect those of IFPRI, PIM, or CGIAR. The authors are responsible for all remaining errors.

1. Introduction

Poor nutrition is a global challenge that goes beyond poor and unsafe food. The chances of achieving healthy, strong and resilient livelihoods are decreased as a result of malnutrition. Poor nutrition has been found to lead to an 11 percent reduction in gross national product through reduction in labor force earnings, less learning in school, and days lost to illness (Global Nutrition Report 2014). Improving households' nutrition, especially in developing countries, requires understanding the intricacies and challenges that they face. Nutrition among households is intricately linked to labor productivity, household health, and livelihoods. Without good nutrition, households are likely to encounter a decline in welfare and increased incidence of diseases. Globally, 794 million people are estimated to be calorie-deficient, with 161 million children under-5 years too short for their age and 51 million children under 5 years stunted for their age (Global Nutrition Report 2015). Malnutrition is a leading cause of higher incidence of diseases such as diarrhea. Poor nutrition is also a leading but often silent cause of decreased welfare for most households in Africa. While it is expected that households would have access to good nutrition as countries make economic progress, a decline in household welfare levels and increased incidence of disease could make achieving good nutrition difficult. A general consensus among health and nutrition researchers and practitioners is that health, nutrition, and household income are linked together to determine the functionality of agricultural food systems (Pinstrup-Andersen 2007; Levitt et al. 2011; Gómez et al. 2013).

This is also the case for Nigeria since the majority of the agricultural households dwell in rural areas and depend on agriculture for their livelihoods. Nutrition outcomes among young children in Nigeria are among the worst globally (Haddad et al. 2015). The 2013 Demographic and Health Survey (DHS) data for Nigeria show that 43 percent of rural under-5 children (50 percent among less educated mothers) are too short for their age (that is, stunted or height-for-age z-score [HAZ < -2), while nationally, 18 percent of under-5 children are too thin for their height (that is, wasting or weight-for-age z-score [WHZ < -2). The report further shows very low levels of educational attainment for women. About 54 percent of women in rural areas never attended school, and only half of all children attend school by age 6, with more girls dropping out before age 15. More importantly, this work contributes to the limited in-depth studies and empirical documentation of the key drivers of child undernutrition in Nigeria (National Population Commission and ICF International, 2014).

Nigeria is moving in the right direction in recent years, through the Agricultural Transformation Agenda (ATA)[1] of 2011 (Nigeria, FMARD 2011; Africa Lead–IFPRI 2012; Babu et al. 2014) and more recently through the launch of the Agriculture Promotion Policy (APP) (Nigeria, FMARD 2016)[2], in dealing with the transformation of the agricultural sector and

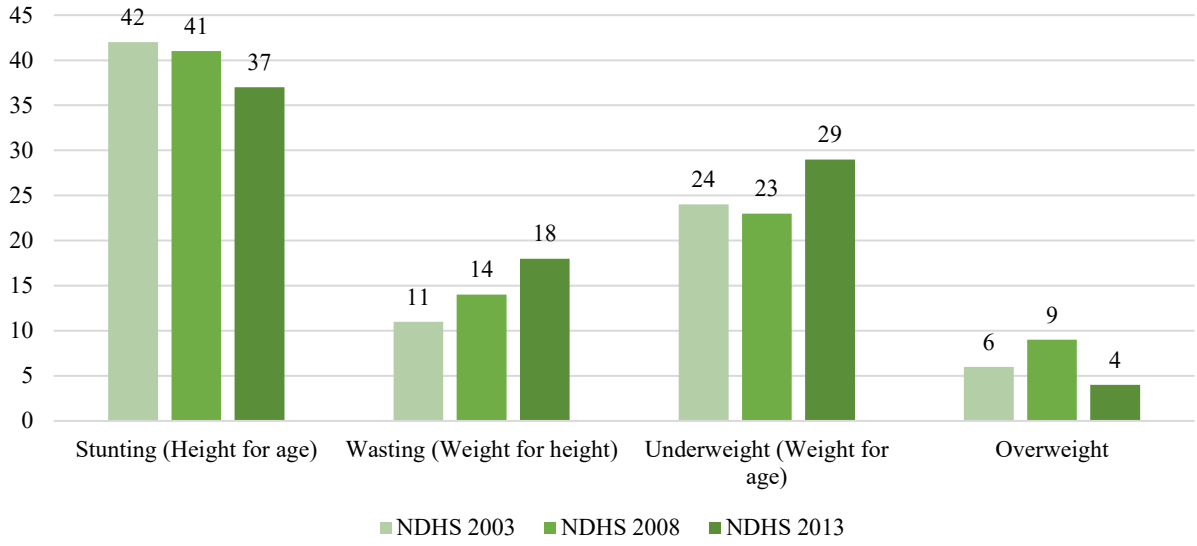
[1] The ATA was designed to complement the Comprehensive Africa Agriculture Development Programme (CAADP) in Nigeria to better suit the country's development pace. The agenda aimed to increase productivity and value addition in agriculture to reduce food prices and reliance on food imports. To reduce Nigeria's reliance on oil, the ATA promoted key commodity value chains with an emphasis on engaging women and youth in the agricultural transformation process. The ATA was a renewed platform to re-engage key stakeholders in Nigerian agriculture and to shift focus on how to make Nigeria's agriculture more productive, efficient, and effective.

[2] The Buhari Administration introduced the APP 2016-2020 in July 2016 to address the gaps of the ATA. The APP focuses on food security; import substitution; job creation; and economic diversification. This new policy is founded on several guiding principles that are carry-overs from the ATA reflecting the strong desire for policy continuity and stability (Nigeria, FMARD 2016).

malnutrition challenges in the country through well-targeted interventions, incentives for both the private and public sectors, and empowerment of women and children. Nevertheless, there is still a need for increased efforts to improve nutrition of households in Nigeria, as also stressed in the new strategy of nutrition and food security launched by the Federal Ministry of Agriculture and Rural Development (FMARD) in May 2017 (Nigeria, FMARD 2017).[3] An insurgency, due to Boko Haram terrorist activities, in some north-eastern states of the country in recent years that resulted in displacement of families and loss of household wealth also increases the risks of poor nutrition among household members, especially women and children. It has also been argued that Nigeria may be missing out in addressing the micronutrient needs of Nigerian households both in policy and implementation efforts to include consumption of fortified food in every diet (Robinson and Humphrey 2014). One out of every two deaths among children in Nigeria is caused by poor nutrition as a result of nutrient deficiency (Nigeria, Federal Ministry of Health 2014). Trend analysis using the DHS for Nigeria (Figure 1) shows that the number of underweight children under five years old have increased from 24 percent and 23 percent in 2003 and 2008, respectively to 29 percent in 2013. The rate of wasting has also increased to 18 percent in 2013 from 14 percent and 11 percent in 2008 and 2003, respectively, with a slight decrease in the rate of stunting to 37 percent in 2013 from 42 percent in 2003. Households in Nigeria, especially those located in rural areas and northern states, still face numerous challenges in terms of nutrition and health outcomes. Limited dietary diversity among households determined culturally, socially and economically plays a significant role in household nutrition in Nigeria (Kuku-Shittu et al. 2016) and an understanding of the impact of welfare measured using the DHS wealth index on nutrition and disease incidence would provide the much-needed leeway for nutrition policy for agricultural households in Nigeria. Ecker, Hatzenbuehler, and Mahrt (2018) report results of an estimation of the relationship between dietary diversity and the HAZ in Nigeria which suggest a weak, but statistically significant and positive relationship between these variables. The authors argue that this implies that efforts to improve dietary diversity in Nigeria will plausibly reduce malnutrition and improve health outcomes.

[3] The relevant FMARD report stresses that "the agricultural sector especially has a unique role to play because it is the source of food; it affects the incomes of the majority of the population; [and] it influences food prices" (Nigeria, FMARD 2017, p. ix). It further notes that "ongoing efforts to transform the agricultural sector in Nigeria especially prioritize improved food security and nutrition as a fundamental outcome" (Nigeria, FMARD 2017, p. ix).

Figure 1: Trends in nutritional status of children under age 5, 2003-2013



Source: National Population Commission (NPC) [Nigeria] and ICF International (2014).
Note: NDHS = Nigeria Demographic and Health Survey.

Against this background, this paper makes two contributions to the literature regarding the linkage between household welfare on the one hand, and nutrition and disease incidence on the other, and on how they all interact among households in Nigeria. First, we evaluate the impact of nutrition and disease incidence on welfare among households in Nigeria with a particular focus on children and women using the DHS data collected for Nigeria in 2003, 2008, and 2013. To the best of our knowledge, very limited study has been done on this in Nigeria and analysis using the above dataset that covers 3 5-year periods spanning 15 years has not been done. Second, we determine the factors that condition nutritional status and influence the nutritional outcomes of households in both rural and urban areas of Nigeria using the same dataset. The rest of the paper is structured as follows: section 2 presents a brief review of the literature on nutrition, health and disease incidence, and wealth index as a measure of welfare. The empirical framework and data are presented in section 3, while section 4 presents results of the analysis, followed by concluding section 5.

2. Literature Review: Nutrition, Welfare, and Disease Nexus

It has been argued that increased consumption of more nutritious food could lead to improved welfare, socially and economically (Msangi and Rosegrant 2012, Hoddinott 2012). While lower levels of household welfare could be associated with poor nutrition intake and increased incidence of diseases among household members, higher nutritional status is seen as key in improving household welfare. Few studies have evaluated the welfare impact of nutrition and disease incidence among agricultural households more explicitly (Moradi 2010; de Walque et al. 2011; Muller 2009). A study of 200,000 women in 28 countries in Africa south of the Sahara showed that a decline in economic welfare had a negative impact on the level of growth experienced at different stages of the individuals' life-cycle despite their high nutritional intake (Moradi 2010). The study also showed that the disease environment and the level of protein intake determines the level of nutritional status. Using consumption and income as a measure of economic welfare,

Appleton (1996) finds that other social indicators such as education influence the level of welfare of both male- and female-headed households in Uganda. De Walque et al. (2011) find a decline in the welfare and nutritional status of households in Mozambique irrespective of the HIV status of the household. This outcome was the result of better access to healthcare for households with HIV, but households which experienced a negative income shock and food crisis had reduced the chance of progressing in their treatment regimen. In an assessment of the health and nutritional outcomes of households that depend solely on their agricultural output in Rwanda, Muller (2009) found that while households with greater agricultural diversity in terms of output produced on the farm had a positive impact on health and nutrition, off-farm production, like alcohol production, had a negative impact on health. One would expect that since the households assessed depend solely on their agricultural production whether on-farm or off-farm, high consumption of alcohol could lead to detrimental health conditions. With the possibility that household that have off-farm income to supplement on-farm income and therefore increase household welfare for better consumption during off-season, Babatunde and Qaim (2010) examined the impact of off-farm income on food security and nutrition among households in Nigeria using a structural model. They found that households with off-farm income had better food production with increased income that contributed to higher levels of welfare among them. Among Ghanaian children, Asenso-Okyere, Asante, and Nubé (1997), by using both bivariate and multivariate analysis, found that children with better access to vaccination and disease prevention mechanisms have higher nutritional status. Croppenstedt and Muller (2000) investigated the effect of nutritional status and health on the productivity and efficiency of households in Ethiopia. The results revealed that a higher market wage rate that represents increased welfare leads to an increased response to nutritional status, with greater returns to investment in nutrition. Households in Kenya with greater assets and better access to health care with lower disease incidence have higher nutritional status (Kabubo-Mariara, Ndenge, and Mwabu 2009).

Using decomposition and regression analysis, Ssewanyana and Kasirye (2012) examined the determinants of health inequalities among children in Uganda and found that the welfare of the households is a strong determinant factor of the nutrition and health status of children. While households with sick people spend less time on farm activities that would increase the efficiency of agricultural production, an increase in health investment to increase agricultural efficiency may not lead to an increase either in welfare or poverty reduction (Ulimwengu 2009). Glewwe, Agrawal, and Dollar (2004) investigated the relationship between household income and nutritional status in Vietnam and found that growth in household income accounts for a small proportion of children's nutritional status. Ruel et al. (1992) show that, among wealthier households in Lesotho, the effect of a mother's education on wasting is mediated by the mother's nutrition knowledge—but not among poor households. Another study found, by using DHS data from across developing countries, that significant effects of parents' education on child nutrition outcomes are only strongly observed when parents have an education beyond primary (Alderman and Headey 2017). In the context of developing countries where the literacy rate is low and income inequality is high, Block (2007) and Van den Broeck (2007) argue that maternal nutrition and health knowledge obtained outside of school can substitute for education in producing good health outcomes for children.

In a major study using data from 11 DHSs to examine the association between dietary diversity and HAZ for children 6–23 months old, while controlling for household wealth/welfare and several other potentially confounding factors, Arimond and Ruel (2004) found that dietary diversity was significantly associated with HAZ, either as a main effect or in an interaction, in all

but one of the countries analyzed. These findings suggest, according to the authors, that there is an association between child dietary diversity and nutritional status that is independent of socioeconomic factors, and that dietary diversity may indeed reflect diet quality.

Alderman and Headey (2017) and Amare et al. (2018) found that education below the junior secondary education level may not affect the nutrition status of young children in a population with low levels of education. Furthermore, Benson et al. (2017) reveal that primary education in Nigeria does not include curricula on public health nutrition, while the third year of secondary school (junior secondary) does deliver a course on nutrition. Masters et al. (2018a) have rightly argued that improving maternal and child nutrition in resource-poor settings requires effective use of limited resources, but priority-setting is constrained by limited information about program costs and impacts, especially for interventions designed to improve diet quality. In their study they utilized a mixed methods approach to identify, describe, and estimate the potential costs and impacts on child dietary intake of 12 nutrition-sensitive programs in Ethiopia, Nigeria, and India. Potential interventions included conditional livestock and cash transfers, media and education, complementary food processing and sales, household production, and food pricing programs. The results, according to the authors, add substantial value to the limited literature on the costs and dietary impacts of nutrition-sensitive interventions targeting children in resource-limited settings, informing policy discussions and serving as critical inputs to future cost-effectiveness analyses focusing on disease outcomes. Finally, another very recent study by Masters et al. (2018b) demonstrated the feasibility of a structured process to leverage local expertise in formulating a program tailored for current circumstances in South Asia and Africa. The authors assembled 41 stakeholders in 2 regional workshops and followed a prespecified protocol to elicit program designs listing the human and other resources required, the intervention's mechanism for impact on diets, target foods and nutrients, target populations, and contact information for partners needed to implement the desired program. The results emanating from that study demonstrate, according to the authors, that a participatory process can help local experts identify their own priorities for future investments, as a first step in a novel process of rigorous, transparent, and independent priority setting to improve diets among those at greatest risk of undernutrition.

2.1 Wealth Index as a Measure of Household Welfare

Household welfare is usually measured by using the available information on household consumption, expenditure and income. However, this piece of information is rarely collected in household surveys due to the huge resource requirement and extensive data collection required to capture such information (Vyas and Kumaranayake 2006). The wealth index is a constructed indicator that captures expenditure and income measures using data on household ownership of durable assets, access to infrastructure and household characteristics using principal component analysis. Some of the drawbacks of using the wealth index as a measure of welfare are the inability to capture short run welfare, limitation of the wealth index to capture the quality of household assets and the relative measure of the assets households own in rural and urban areas bias in terms of economic contexts and issues related to aggregation of household assets (Rutstein and Johnson 2004; Falkingham and Namazie 2002; Montgomery et al. 2000; Moser 1998). Apart from the availability of wealth index in the DHS data for Nigeria, the wealth index reflects long run household wealth and standard of living of households (Filmer and Pritchett 2001; Rutstein and Johnson 2004). While this may be seen as a shortcoming for using the wealth index as a measure of welfare in the short run, using the wealth index as a proxy for household welfare when analyzing

nutrition and health (Sahn and Stifel 2003) would be an appropriate approach since measures of malnutrition—height for weight, height for age, and weight for age—are reflections of the long-run effects of nutritional intakes. For the purpose of this paper, Nigeria households in the poorer and poorest wealth index are considered to have a lower level of welfare, while households in the richest, richer, and middle wealth index are considered to be in the higher level of welfare.

3. Empirical Framework

Specifically, the nutritional status of a child N is determined by household welfare level (W), child's genetic health endowment or characteristics (C), mother's nutritional status (S), and health and disease incidence (H) given as:

$$N = f(W, C, S, H) \quad \text{.. (1)}$$

While the child's genetic endowment defines all intrinsic characteristics that influence child wellbeing and health, it is exogenous and not collected in most household data collected (Glewwe, Agrawal and Dollar 2004). Other characteristics of the child are captured in the child's age and gender. The household welfare is captured using the wealth quintiles that households fall into. The nutritional status of the child is captured by the level of malnutrition of the child while the health and disease incidence are captured in the frequency of diarrhea and fever among children. A unique characteristic of the DHS data is that information is collected among households in clusters. In order to capture the cluster effects, a multi-level mixed-effects probit model that contains both fixed and random effects is used (Rabe-Hesketh and Skrondal 2012). We use a two-level mixed effects probit model to empirically identify both fixed and random effects based on the different clusters of households used in the DHS sample. The random effects model allows for modelling intracluster correlation that could arise in observations of the same cluster that are correlated because they share common cluster-level random effects. This paper uses a two-level mixed-effects probit model that specifies a random effect for clusters in the DHS children recode samples and then random effects for households nested within the clusters. Following Maddala (1983), the probit model assumes that

$$Pr\left(y_{ij} = 1 \middle| V = v\right) = \Phi(x'\beta), \quad \text{..(2)}$$

Where y is a binary response variable, V is a vector of regressors and Φ is the cumulative distribution function of the standard normal distribution. In the two-level model, the observations from households' members make the first level while the cluster with the households comprise the second level. M represents independent clusters and is conditional on a set of fixed effects x_{ij} and a set of random effects u_j. Thus equation 2 can be expressed as;

$$\Pr\left(y_{ij} = 1 \middle| x_{ij}, u_j\right) = \mathrm{H}(x_{ij}\beta + z_{ij}u_j) \quad \text{...(3)}$$

For $j = 1, \dots, M$ clusters, with cluster j consisting of $i = 1, \dots, n_j$ household observations. The nutritional level of household children is the binary valued $y_{ij} = 1$ if $depvar_{ij} \neq 0$ and $depvar_{ij} \neq 0$ and $y_{ij} = 0$ otherwise. The $1 \times p$ row vector x_{ij} are the covariates for the fixed effects. The $1 \times q$ vector z_{ij} represents the random effects. The random effects u_j are M realizations from a multivariate normal distribution with mean 0 and $q \times q$ variance matrix Σ.

The random effects are not directly estimated as model parameters but are instead summarized according to the unique elements of Σ, known as variance components. One special case of (2) places $z_{ij} = x_{ij}$, so that all covariate effects are essentially random and distributed as multivariate normal with mean β and variance Σ. H$(\cdot)$ is the standard normal cumulative distribution function, which maps the linear predictor to the probability of a success $(y_{ij} = 1)$ with $H(v) = \Phi(v)$ (Imai, King, and Lau 2008). The *stochastic* component is described by a Bernoulli distribution with mean vector π_{ij}.

$$Y_{ij} \sim Bernoulli(y_{ij}|\pi_{ij}) = \pi_{ij}^{y_{ij}}(1-\pi_{ij})^{1-y_{ij}}$$

where

$$\pi_{ij} = \Pr(Y_{ij} = 1)$$

Equation (3) can be expressed as;

$$y_{ij}^* = X_{ij}\beta + z_{ij}u_j + \epsilon_{ij} \quad \text{..... (4)}$$

$$y_{ij} = \begin{cases} 1 \; if \; y_{ij}^* > H_{ij} \\ 0 \; otherwise \end{cases}$$

The errors ϵ_{ij} are distributed as a standard normal with mean 0 and variance 1 and are independent of u_j. y_{ij}^* denotes the latent variable; presence of child malnutrition, X_{ij} is a vector of regressors that include household characteristics in the DHS data (i.e., [1] level of household welfare proxied by the wealth index[4] of the households; [2] mothers' characteristics using educational level of the respondents, age of the respondent, household size, gender of household head, work status of the respondent and presence of extra child burden; [3] respondents' child characteristics using age of the respondents' child and gender of respondents' child; [4] Respondent's nutritional level measured using body mass index; [5] health and disease incidence proxied by incidence of diarrhea among respondents' child, incidence of fever among respondents' child, number of health visits by respondents and presence of child vaccination (see Table 1 in the next section for the dependent and independent variables used). Detailed information on the data and variables used are presented in the next sub-section.

3.1 The Nigerian Demographic and Health Survey (DHS) Data

The DHS data for Nigeria was first collected in 1990 and since then there have been four further rounds of DHS data collection in Nigeria, in 1999, 2003, and 2008, with the most recent DHS implemented in 2013 by the National Population Commission. To make all the DHS data collected for Nigeria comparable for all the surveys conducted, the 1990 and 1999 surveys were dropped since some variables of interest in our analysis were not collected in these two DHS surveys. Data collected by the DHS for Nigeria were on fertility levels, marriage, fertility preferences, awareness and use of family planning methods, child feeding practices, nutritional status of women and children, adult and childhood mortality, awareness and attitudes regarding HIV/AIDS, and

[4] The wealth index is a composite measure of a household's cumulative living standard. This makes the wealth index a very good proxy for measuring household welfare. The wealth index is a measure of welfare that is calculated using easy-to-collect data on a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities. The DHS wealth index is generated using principal component analysis that places individual households on a continuous scale of five relative wealth quintiles.

domestic violence. The data used in this study were sourced from three rounds of DHS, which are nationally representative surveys of reproductive-age women (15-49) and their children (<60 months) conducted in Nigeria in 2003, 2008, and 2013. Data was collected on the demographic and socioeconomic characteristics and nutritional and health status of the women and children involved in the survey. The sample for the 2003 DHS data containing 7,864 households was selected using a stratified two-stage cluster design of 365 clusters based on the 1991 population census enumeration areas (EA). Only 7,225 households were successfully interviewed (National Population Commission [NPC] [Nigeria] and ORC Macro 2004). A total of 7,620 women were interviewed in the woman questionnaire with information from 6,029 women and their children collected in the children recode data used in this paper. After cleaning the 2003 DHS data, only 3,315 complete observations were used in this study. The sample for the 2008 DHS data containing 36,800 households was selected using a stratified two-stage cluster design of 888 clusters in 286 and 602 urban and rural areas, respectively, in Nigeria. However, only 34,644 households were occupied at the time of the survey with a total of 886 clusters and 34,070 households being successfully interviewed (National Population Commission (NPC) [Nigeria] and ICF Macro 2009). A total of 33,385 women were interviewed in the woman questionnaire, with information from 28,647 women and their children collected in the children recode data used in this paper. After cleaning the children recode data, only 13,739 complete observations were used in this study. Finally, the 2013 data covered a nationally representative sample of the entire Nigerian population living in non-institutional dwelling units of all the states and federal capital territory of the country. The sample for the 2013 DHS data containing 40,680 households was selected using a stratified three-stage cluster design of 904 clusters in 372 and 532 urban and rural areas, respectively, in Nigeria. This sample represents the largest sample of DHS collected since its inception for Nigeria. However, only 896 clusters and 38,904 households were occupied at the time of the survey with a total of 38,522 households successfully interviewed (National Population Commission (NPC) [Nigeria] and ICF International 2014). A total of 38,948 women were interviewed in the woman questionnaire with information from 31,482 women and their children collected in the children recode data used in this paper. After data cleaning, only 16,125 complete observations were used in the present study.

The primary sampling unit based on the population census EA is referred to as a cluster. Each cluster number is the number identifying the sample point as used in the sample. Three questionnaires (see household, man and woman questionnaires) were modelled based on the MEASURE DHS program to suit country-specific needs. Information on women aged (15-49 years) and children aged (0-59 months) within the listed households was collected in the woman questionnaire, while information about men aged (15-49 years) was collected in the man questionnaire. Only the children recode data from the woman questionnaire, which has information on both women and children in the listed households, was used for all three years for this paper. Since the sample size and households interviewed for the three years do not match, separate analysis of the three years in question and pooled analysis is done. Separate analysis of the data collected in the three years is necessary to ascertain the pattern of change over 15 years in Nigeria. Table 1 provides full details regarding the definition of variables used in the analysis. Descriptive statistics, results, and discussion of the results from the multilevel mixed-effects probit model using DHS data for 2003, 2008, 2013, and pooled data from the three years used, are presented in the next section.

Table 1: Description of variables used

Variables	Description
Dependent variables: Presence of child malnutrition	
Child stunting	Prevalence of stunting-height/age among children *(prevalence of stunting=1, no prevalence of stunting=0)*
Child underweight	Prevalence of underweight-weight/age among children *(prevalence of underweight=1, no prevalence of underweight=0)*
Wasting	*Prevalence of wasting (prevalence of wasting=1, no prevalence of wasting=0)*
Independent variables: Household welfare level	
Wealth index	Wealth index *(1=poorest, 2=poorer, 3=middle, 4=richer, 5=richest).*
Respondents' characteristics	
Edulevel	Educational level of the respondent *(1=no education, 2=primary, 3=secondary, 4=higher)*
Age	Age of the respondent *(in years)*
Hhsize	Size of household
Henhhd	Gender of household head *(household head is female=1, household head is male=0)*
Womenjob	Occupation in agricultural sector *(works in the agricultural sector=1, does not work in the agricultural sector=0)*
Childburden	Presence of extra child burden: This was derived from the difference between the ideal number of children that households expect to have and the number of children that they have *(extra child burden=1, no extra child burden=0)*
Respondents' child characteristics	
Childageyr	Age of respondent's child *(in years)*
Childgender	Gender of child *(female=1, male=0)*
Respondent nutritional status	
Bmi	Body mass index of mother
Health and disease incidence	
Childiarrhea	Child had diarrhea recently *(child had diarrhea=1, child did not have diarrhea=0)*
Childfever	Child had fever recently *(child had fever=1, child did not have fever=0)*
Healthvisit[5]	Had access to health facility? *(yes=1, no=0)*
Vaccine	Gave child vaccination *(yes=1, no=0)*

Source: Authors' compilation based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

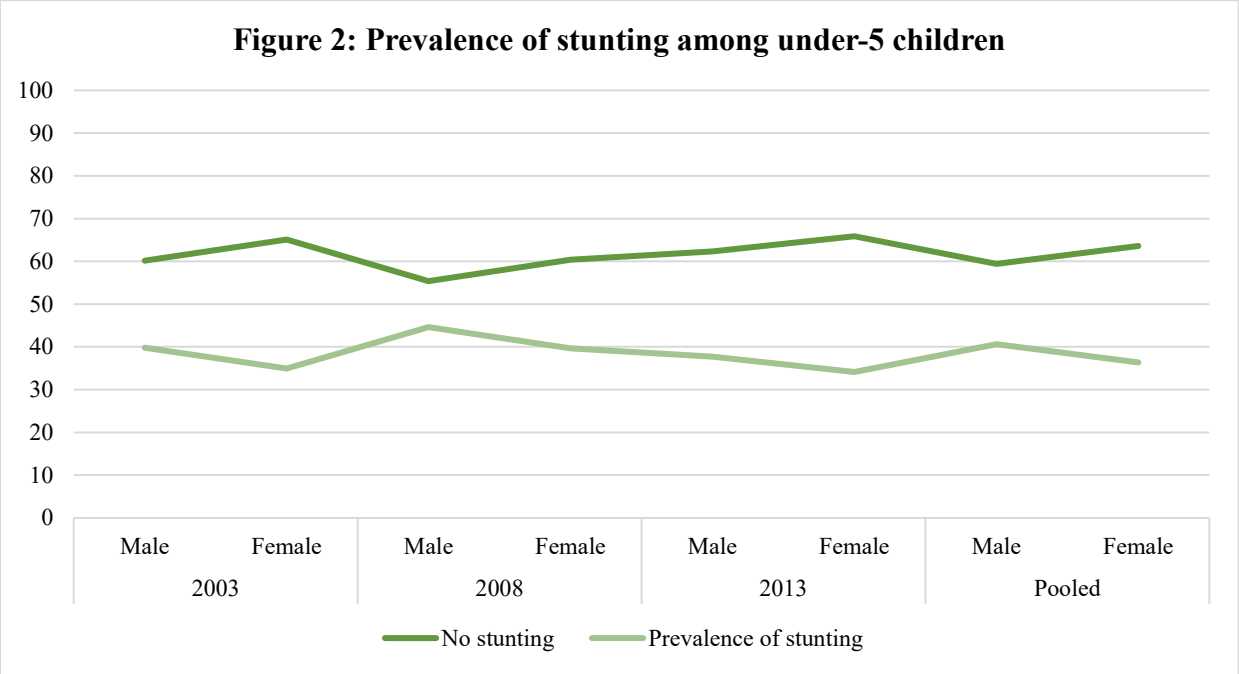
4. Descriptive Analysis, Empirical Results, and Discussion

4.1 Malnutrition-Wealth Nexus

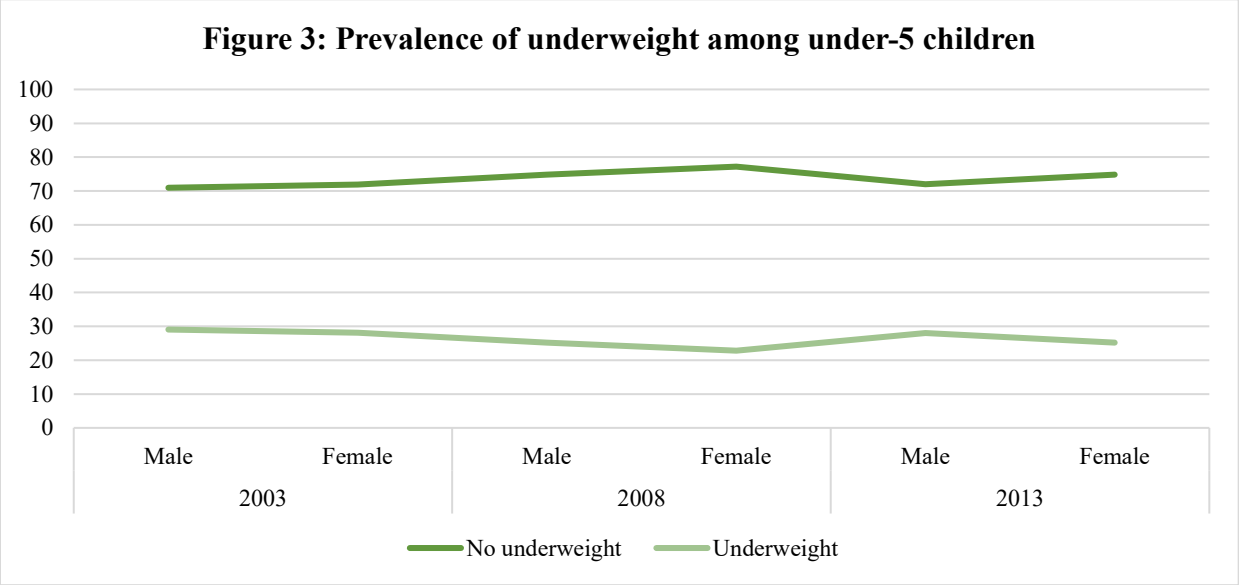
Overall, the prevalence of stunting was higher in male children under 5 than female ones in all the years considered, with the highest level of stunting among male children in 2008. This trend is also seen for prevalence of underweight among children under 5 years but with a wider gap between those that are underweight and those that are not (Figures 2 & 3). Thirty-seven percent of children under five years old are stunted. Prevalence of stunting is lowest among children aged less than one year but increases for children aged 1-4 years old. One-fourth of the children that are stunted are in the poorest wealth index, signifying that a higher level of stunting is associated with

[5] While access to health facilities does not necessarily improve health, it increases the chances of getting health care when needed.

a lower welfare level. The proportion of adults who are malnourished decreased by over 25 percent in 2013 as compared to those who were malnourished in 2008.



Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

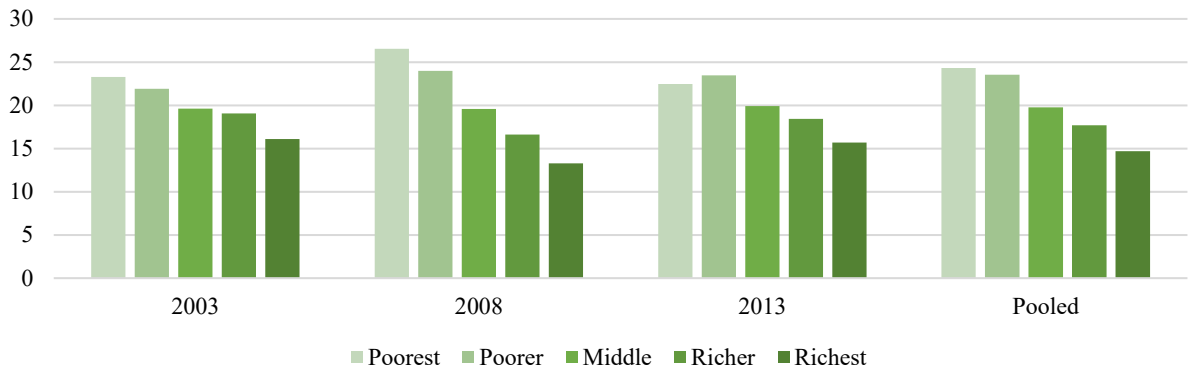


Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

About 45 percent of the DHS samples were in the poorer and poorest wealth level in 2003 and 2013, with an even higher proportion of over 50 percent in the poorer and poorest wealth index in

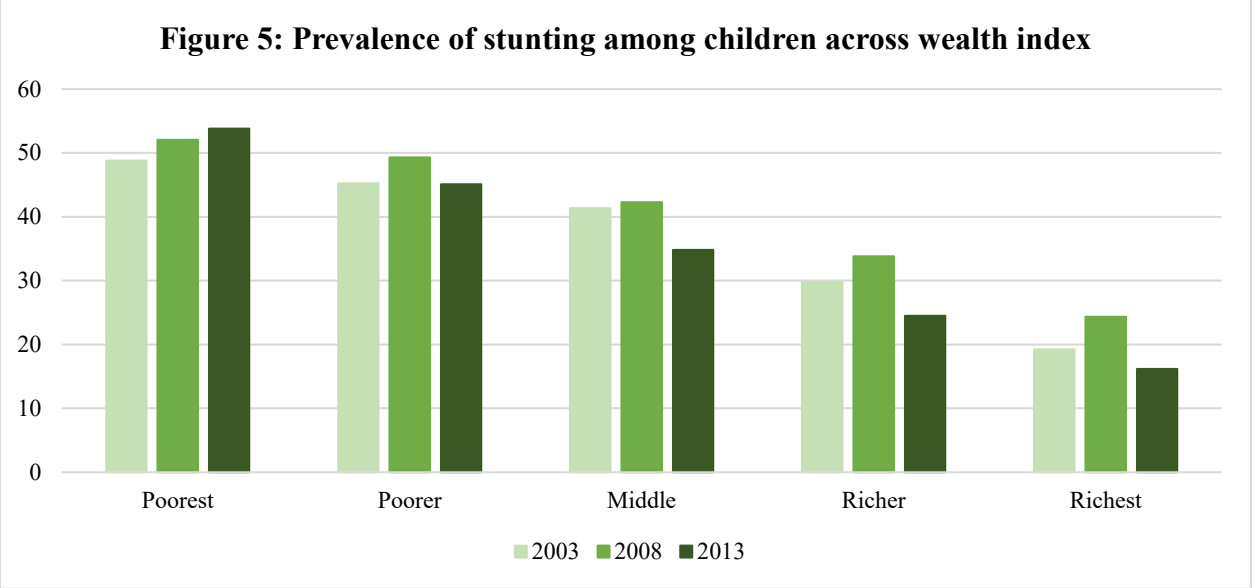
2008. Eleven percent of the rich in the wealth index in the DHS samples reside in rural areas and this proportion did not change over the three years under investigation.
The highest proportion of poor people in the DHS samples also reside in rural areas. This could imply that those in rural areas have lower welfare and that the welfare status of those who are in the poorer and poorest index has not changed over time. Also, indicating that the chance of wealth acquisition and movement from the lower wealth index to the higher wealth index in rural areas is very low. In general, the overall household welfare and health in the DHS samples declined between 2003 and 2008 and then increased in 2013 slightly above the level it was in 2003 (Figure 4).

Figure 4: Percentage distribution of wealth index (2003, 2008, 2013 & Pooled)



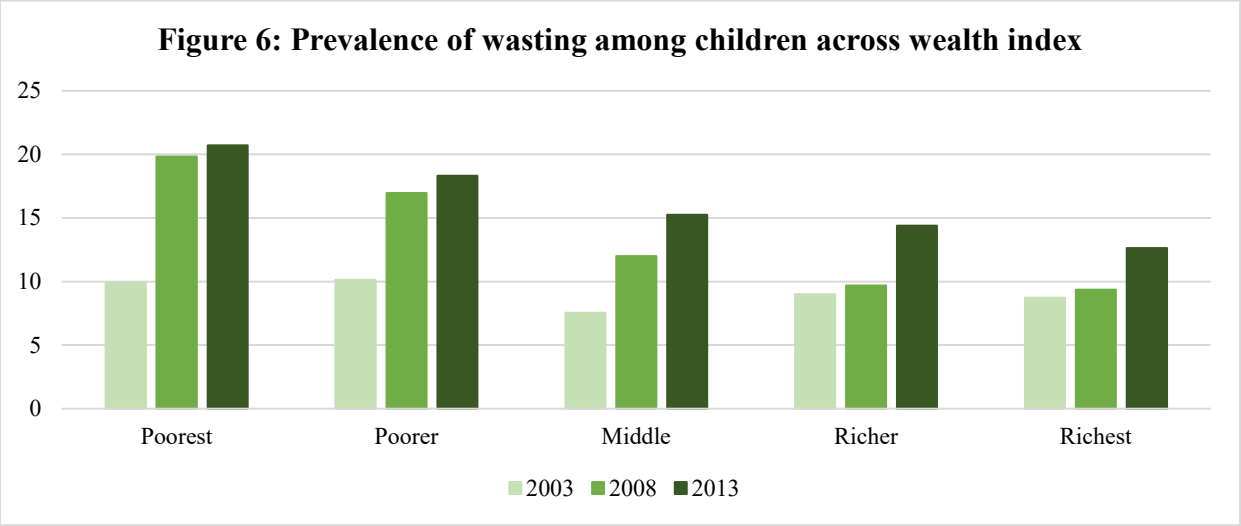
Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

Prevalence of stunting is higher among those in the poorer and poorest wealth indexes, with about 50 percent in both groups having children who are stunted (Figure 5). A lesser proportion (about 35 percent) of those in the lower wealth index have children who are underweight with an even lesser proportion (about 18 percent) of underweight children in the higher wealth index levels. This is in line with the argument of Benson and Shekar (2006) about the wealth distributional effects on child nutrition in most countries in Africa.



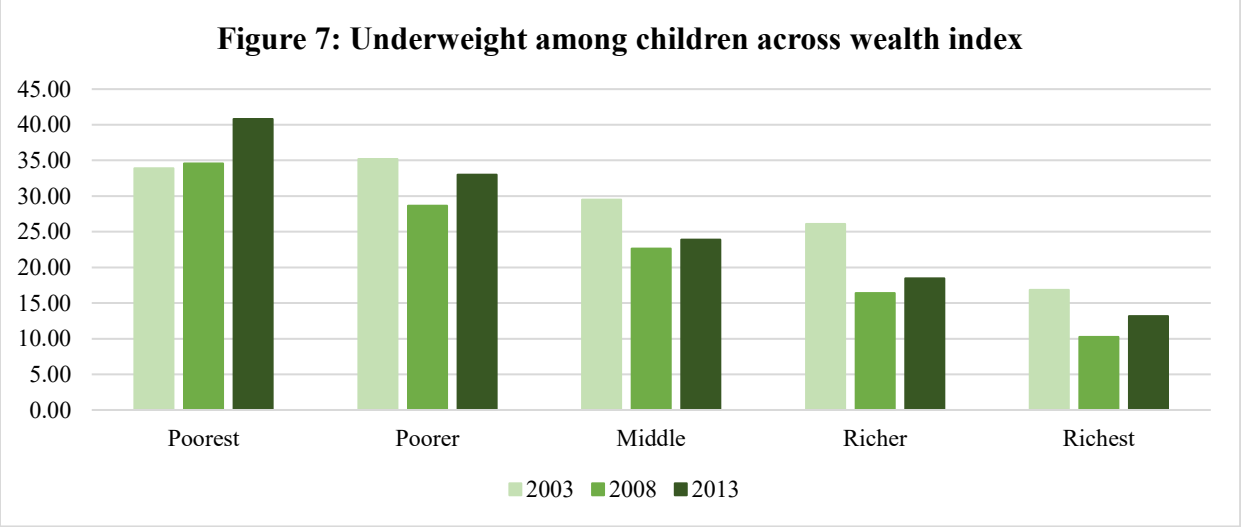
Source: Authors' calculations based on 2003, 2008 and 2013 Demographic and Health Survey (DHS) data for Nigeria.

While the prevalence of wasting is relatively lower than the prevalence of stunting, wasting among children in all the wealth indexes increased in 2013, with the highest prevalence of wasting among children in households in the poorest and poorer wealth index (Figure 6).



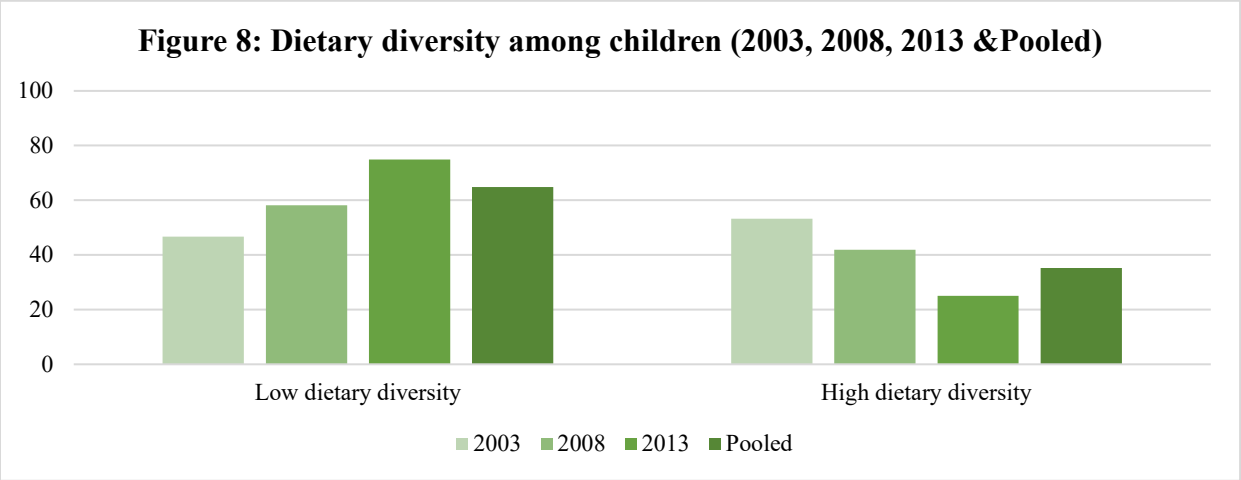
Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

This is also the case for children who were underweight between 2003 and 2013, where the highest proportion of children who are underweight are in the poorest to middle wealth index (Figure 7).



Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

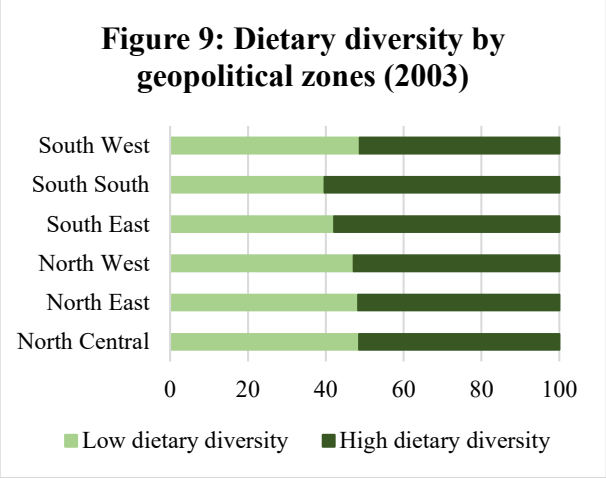
Dietary diversity[6], measured as the number of unique foods consumed by household members over a given period, shows an overall decreasing rate among children between 2003 and 2013, with the lowest rate of dietary diversity being among children in rural areas in 2013. Overall, dietary diversity also decreased from 53 percent in 2003 to 25 percent in 2013 (Figure 8).

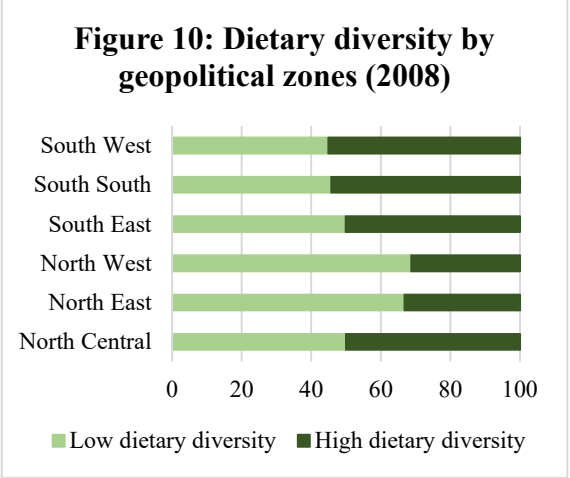


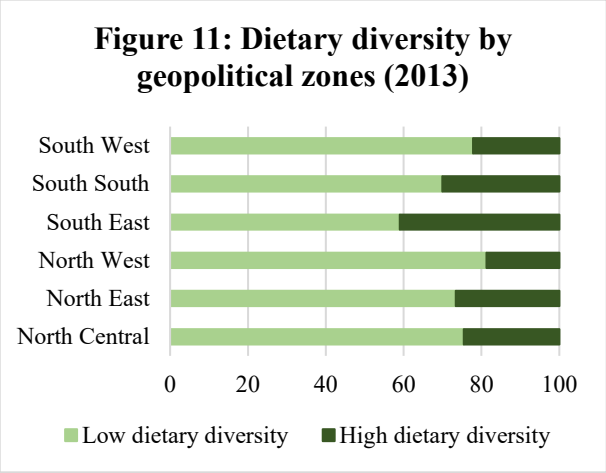
Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

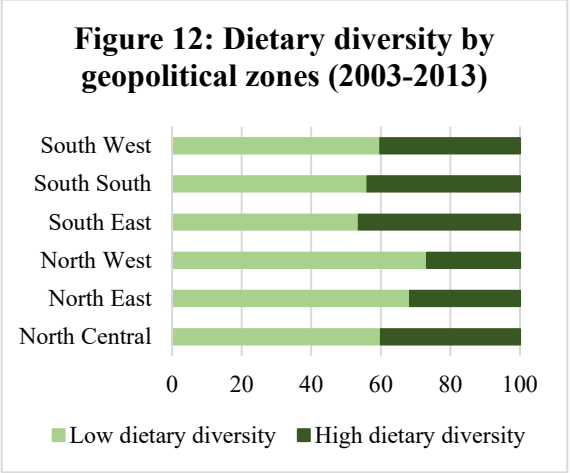
In terms of geopolitical zones' distribution of dietary diversity, states in the northern parts of the country have reduced levels of dietary diversity, with states in the North East and North West most affected in the pool DHS data (Figures 9-12).

[6] Dietary diversity shows the variety of foods across and within food groups that is consumed and a dietary diversity of ≤ 3 is considered low dietary diversity (Kennedy, Ballard, and Dop 2011).









Source: Authors' calculations based on 2003, 2008 and 2013 Demographic and Health Survey (DHS) data for Nigeria.

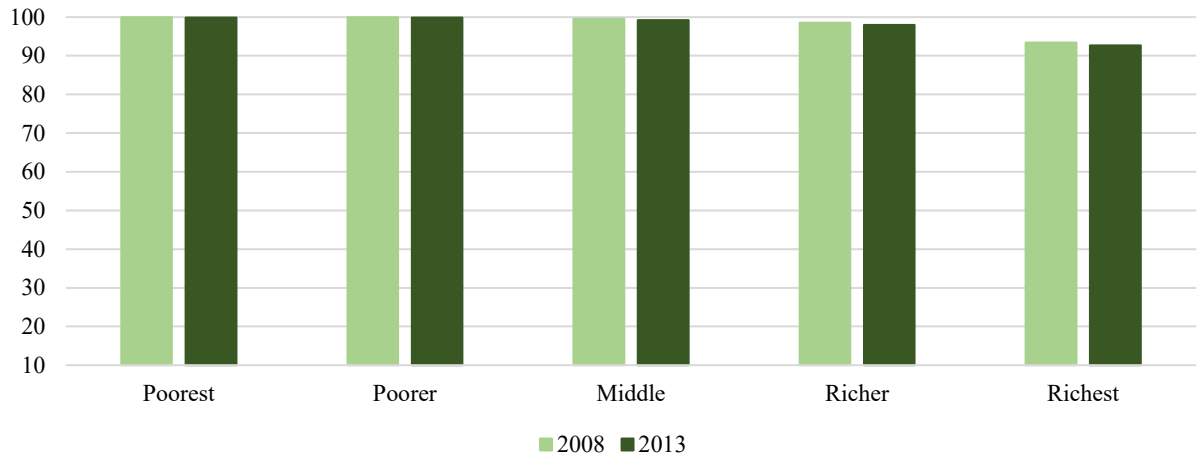
4.2 Right and Access to Health Care: Wealth-Health Nexus

Within the pooled DHS dataset, 53 percent of people in rural areas and 16 percent of people in urban areas do not have access to or have not visited a health facility in 12 months. In 2003, 44 percent of those who did not have a final say[7] on their health care did not visit any health care facility for medical attention. This proportion increased to 47 percent and 48 percent in 2008 and 2013, respectively, with an overall increase of 9 percent between 2003 and 2013. This implies that the proportion of women and their children who have rights over their health have decreased overtime and there is still a huge gap in terms of rights and access to medical help among children and women in Nigeria. Distance to health care facilities also increases the difficulty experienced in getting access to health care, especially among those in rural areas. A significant proportion of women cannot afford health care services, with only those higher in the wealth index able to pay for health care. This implies that the welfare status of the household determines the level of attention that households would give to improving their health status, ceteris paribus. While health insurance services have evolved in recent years in Nigeria, with increased awareness and private-sector participation, the proportion of households that do not have any form of health insurance is still significantly high (over 90%), with more households in the lower wealth index as compared

[7] Having a final say on health care implies that the individual can make major decisions on whether or not to get health care when needed.

to those in the higher wealth index (Figure 13). Households in urban areas have more health cards than those living in rural areas in all the DHS samples, with over 67 percent of those in urban areas in possession of hospital health cards and about 35 percent of those in rural areas with health cards.

Figure 13: Proportion not covered by health insurance by wealth index (2008 and 2013)



Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

Table 2 provides summary statistics of the DHS samples (2003, 2008, 2013, and Pooled) used in the empirical analysis.

Table 2: Summary statistics of the DHS samples (2003, 2008, 2013, and Pooled)

Variable	2003		2008		2013		Pooled	
	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Incidence of child malnutrition - Stunting	0.41	0.49	0.45	0.50	0.41	0.49	0.43	0.50
Incidence of child malnutrition - Underweight	0.31	0.46	0.27	0.44	0.31	0.46	0.29	0.45
Incidence of child malnutrition - Wasting	0.94	0.29	0.16	0.36	0.18	0.38	0.16	0.37
Wealth index								
Poorer	0.22	0.42	0.25	0.43	0.26	0.44	0.25	0.43
Middle	0.21	0.41	0.20	0.40	0.20	0.40	0.20	0.40
Richer	0.18	0.39	0.16	0.36	0.16	0.37	0.16	0.37
Richest	0.14	0.34	0.11	0.31	0.12	0.33	0.12	0.32
Educational level								
Primary	0.24	0.43	0.23	0.42	0.20	0.40	0.22	0.41
Secondary	0.19	0.40	0.19	0.40	0.22	0.41	0.21	0.41
Higher	0.30	0.17	0.03	0.18	0.04	0.21	0.04	0.19
Age	28.89	6.99	29.35	7.13	29.45	7.01	29.35	7.06
Childageyr	1.93	1.41	2.08	1.42	2.09	1.42	2.07	1.42
Hhsize	7.40	3.69	7.26	3.64	7.32	3.59	7.30	3.62
Genhhd	0.09	0.29	0.09	0.29	0.10	0.29	0.09	0.29

Healthvisit	0.42	0.49	0.24	0.43	0.26	0.44	0.27	0.44
Bmi	22.22	3.98	22.21	4.07	22.83	4.13	22.52	4.10
Vaccine	0.71	0.45	0.66	0.48	0.73	0.44	0.70	0.46
Childgender	0.49	0.50	0.51	0.50	0.51	0.50	0.51	0.50
Childiarrhea	0.19	0.39	0.11	0.31	0.11	0.31	0.12	0.32
Childfever	0.33	0.47	0.16	0.37	0.12	0.33	0.16	0.37
Womenjob	0.77	1.08	0.70	0.54	0.71	0.50	0.71	0.60
Childburden	0.05	0.21	0.06	0.24	0.63	0.24	0.06	0.24

Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.
Note: DHS = Demographic and Health Survey; see Table 1 for variable descriptions.

4.3 Impact of Welfare and Disease Incidence on Child Nutrition-Prevalence of Stunting

Empirical results of the mixed-effects regression on the impact of welfare and disease incidence on prevalence of stunting among children are presented in Table 3. The estimated variance and standard errors of the random intercept at the clusters for all the DHS data are also presented in Table 3. Most of the findings are generally in line with some theoretical reasoning and previous empirical studies on welfare and nutrition in other countries. With respect to the prevalence of stunting among children in 2003, the results show a negative and significant impact on the wealth index in the richer and richest levels when compared with the reference group - the poorest wealth index. While the wealth index impact is negative, it is not significant for the poorer and middle wealth index households in 2003 and for the poorer wealth index households in 2008. All the wealth index levels are also negative and highly significant for the 2013 and pooled DHS data. While other factors can influence the nutritional level of children, households with lower incomes, assets, and higher levels of poverty (as measured using the wealth index that translates into lower household welfare) are more likely to have children that are stunted as a result of malnutrition (Benson and Shekar 2006). With respect to household characteristics, educational levels—primary, secondary and tertiary—have a negative and highly significant impact on the prevalence of stunting when compared with those without education in all the DHS data used in this paper. This implies that households who are uneducated are more likely to have children who are stunted than those who are educated. The age of the mother also has a negative and significant impact on the prevalence of stunting among children for all the DHS data. Older women are less likely to have children who are malnourished since they may have better childcare experiences. The age of the child has a positive and significant effect on the prevalence of stunting. We expect that as children become older, the effects of the prevalence of stunting become more pronounced and affect child development at the early stages.

Table 3: Results of the mixed-effects probit regression: Incidence of child malnutrition (prevalence of stunting)

Prevalence of stunting	2003	2008	2013	Pooled
Wealth index				
Poorer	-0.11 (-1.43)	-0.06 (-1.74)	-0.11*** (-3.32)	-0.06** (-2.96)
Middle	-0.08 (-1.00)	-0.18*** (-4.66)	-0.26*** (-6.36)	-0.17*** (-6.98)
Richer	-0.26** (-2.99)	-0.32*** (-7.14)	-0.44*** (-9.39)	-0.32*** (-11.61)
Richest	-0.37*** (-3.29)	-0.40*** (-7.14)	-0.58*** (-10.13)	-0.44*** (-12.66)
Educational level				
Primary	-0.14* (-2.23)	-0.12*** (-3.68)	-0.15*** (-4.48)	-0.17*** (-8.47)
Secondary	-0.47*** (-5.62)	-0.28*** (-7.12)	-0.28*** (-7.04)	-0.36*** (-14.55)
Higher	-0.86*** (-4.38)	-0.47*** (-5.83)	-0.55*** (-7.25)	-0.58*** (-11.54)
Age	-0.01*** (-3.63)	-0.01*** (-3.34)	-0.01*** (-3.65)	-0.01*** (-6.09)
Childageyr	0.18*** (9.85)	0.10*** (12.43)	0.12*** (15.83)	0.12*** (21.86)
Hhsize	0.02** (2.93)	0.01* (2.41)	0.01* (2.01)	0.01*** (4.03)
Genhhd	-0.18 (-1.89)	-0.02 (-0.57)	-0.04 (-0.96)	-0.06* (-2.13)
Healthvisit	-0.13* (-2.40)	-0.03 (-0.98)	-0.05 (-1.77)	-0.06** (-3.12)
Bmi	-0.03*** (-4.47)	-0.02*** (-5.61)	-0.02*** (-5.72)	-0.02*** (-10.14)
Vaccine	0.12* (2.01)	0.03 (1.15)	0.04 (1.62)	0.04* (2.45)
Childgender	-0.15** (-3.14)	-0.13*** (-5.49)	-0.12*** (-5.78)	-0.12*** (-8.25)
Childiarrhea	0.28*** (4.34)	0.22*** (5.81)	0.17*** (4.58)	0.21*** (8.63)
Childfever	0.14** (2.63)	0.01 (0.03)	0.11** (3.29)	0.06** (2.88)
Womenjob	0.05* (2.25)	-0.04 (-1.78)	-0.03 (-1.16)	-0.01** (-0.88)
Childburden	0.05 (0.41)	-0.07 (-1.33)	-0.02 (-0.36)	-0.06 (-1.83)
Constant	0.52** (2.75)	0.43*** (5.10)	0.33 (3.94)	0.45*** (8.34)
Random effect *Cluster number*	0.12*** (4.37)	0.08*** (7.93)	0.13*** (9.61)	0.05*** (9.68)
N	3290	13573	16008	32871

Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

Note: t statistics in parentheses (* p<0.05, **p<0.01, *** p<0.001). See Table 1 for variable descriptions.

The nutritional level of the mother has a negative and significant effect on the prevalence of stunting among children. It is expected that mothers with higher nutritional levels would have children who are not stunted since their children can share in the nutrition that is available to them. The gender of the child has a negative and significant impact on the prevalence of stunting, with male children more vulnerable than female children. Children with diarrhea are more likely to be stunted than those who are not. While the results suggest that giving children vaccines would impact nutritional level positively, the impact is not significant. Also, children with fever are likely to be stunted in all the DHS data considered. In 2003, having a job had a positive effect on prevalence of stunting and was slightly significant while having a job is not significant and negatively impacts the prevalence of stunting in 2008, 2013, and the pooled DHS data. While the presence of an unplanned or extra child burden has a positive impact on the prevalence of stunting, the impact is not significant. This result could be due to the insignificant difference between the ideal number of children that households may have and the number of children that households actually have, showing that most households in the DHS samples do not carry the burden of extra children.[8] While the size of the household shows a slightly significant and positive impact on the prevalence of stunting in the three years considered, it is highly significant and also positive for the pooled data.

4.4 Impact of Welfare and Disease Incidence on Child Nutrition-Prevalence of Underweight

Results of the mixed effects regression on the impact of welfare and disease incidence on prevalence of underweight among children are presented in Table 4. The estimated variance and standard errors of the random intercept at the cluster level for all the DHS data are also presented in Table 4. With respect to the prevalence of underweight among children, our analysis in the mixed effects probit model revealed that the wealth index has a negative and significant impact on the prevalence of underweight in all the DHS samples used except the 2003 DHS, where it is negative but not significant. Households that are poor and in the lower welfare level are more likely to have children that are underweight. A similar result is observed with the level of education in the households, with households that are uneducated more likely to have children that are underweight. The age of the mother also has a negative impact on the prevalence of underweight but is not highly significant in the 2008 and 2013 DHS data. The age of the child also has a positive and significant effect on the prevalence of underweight in all the DHS samples. With respect to the size of the household, there is a positive and significant impact on the prevalence of underweight in all the DHS samples except in 2003. The gender of the household head and frequency of visitation to the health facility are not significant in determining the prevalence of underweight. The results also showed that women with better nutrition would have children who are not underweight and vice versa. With respect to the incidence of disease among children, children with diarrhea and fever are more likely to be underweight. The gender of the child shows a negative and significant impact on the prevalence of underweight among children.

[8] Respondents reported both the actual number of children that they have and the ideal number of children that they think they should have. In most cases, the reported ideal number of children was the same as the actual number of children that the respondents have.

Table 4: Results of the mixed-effects probit regression: Incidence of child malnutrition (prevalence of underweight)

Incidence of child malnutrition	2003	2008	2013	Pooled
Wealth index				
Poorer	0.04	-0.08*	-0.10**	-0.05*
	(0.52)	(-2.34)	(-3.09)	(-2.28)
Middle	-0.00	-0.17***	-0.25***	-0.14***
	(-0.04)	(-3.97)	(-5.90)	(-6.54)
Richer	-0.04	-0.24***	-0.36***	-0.18***
	(-0.39)	(-4.67)	(-7.11)	(-7.49)
Richest	-0.14	-0.34***	-0.41***	-0.22***
	(-1.17)	(-4.97)	(-6.57)	(-5.79)
Educational level				
Primary	-0.16*	-0.19***	-0.18***	-0.27***
	(-2.45)	(-5.34)	(-4.74)	(-12.42)
Secondary	-0.35***	-0.35***	-0.24***	-0.39***
	(-4.02)	(-7.54)	(-5.61)	(-14.69)
Higher	-0.43*	-0.42***	-0.57***	-0.61***
	(-2.21)	(-4.17)	(-6.62)	(-10.46)
Age	-0.01**	-0.00	-0.00	-0.00***
	(-3.09)	(-1.54)	(-0.58)	(-2.41)
Childageyr	0.07***	0.07***	0.03**	0.05***
	(3.96)	(7.64)	(3.01)	(8.11)
Hhsize	0.01	0.01***	0.01**	0.01***
	(1.66)	(3.39)	(2.72)	(4.75)
Genhhd	-0.07	-0.03	-0.06	-0.08*
	(-0.78)	(-0.58)	(-1.37)	(-2.60)
Healthvisit	-0.02	-0.08*	0.00	-0.02
	(-0.39)	(-2.23)	(0.05)	(-1.16)
Bmi	-0.05***	-0.04***	-0.03***	-0.04***
	(-6.41)	(-9.99)	(-9.65)	(-16.46)
Vaccine	0.04	-0.05	0.02	0.00
	(0.68)	(-1.65)	(0.73)	(0.16)
Childgender	-0.01	-0.09***	-0.11***	-0.09***
	(-0.11)	(-3.74)	(-5.02)	(-5.58)
Childiarrhea	0.39***	0.24***	0.18***	0.23***
	(6.00)	(5.86)	(4.83)	(9.56)
Childfever	0.22***	0.12***	0.23***	0.16***
	(4.06)	(3.40)	(6.51)	(7.62)
Womenjob	0.01	-0.05	-0.00	-0.01
	(0.46)	(-1.70)	(-0.05)	(-0.92)
Childburden	-0.22	-0.04	-0.11*	-0.12***
	(-1.62)	(-0.71)	(-2.12)	(-3.47)
Constant	0.59**	0.28**	0.27**	0.38***
	(3.02)	(2.84)	(3.18)	(6.50)
Random effect	0.12***	0.15***	0.18***	0.07***
Cluster number	(4.16)	(9.52)	(10.62)	(10.53)
N	3290	13573	16008	32871

Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

Note: t statistics in parentheses (* p<0.05, **p<0.01, *** p<0.001). See Table 1 for variable descriptions.

4.5 Impact of Welfare and Disease Incidence on Child Nutrition-Wasting

Results of the mixed-effects regression on the impact of welfare and disease incidence on child malnutrition in terms of wasting are presented in Table 5. The estimated variance and standard errors of the random intercept at the cluster level for all the DHS data are also presented in Table 5. In 2003, the wealth groups and level of education do not have any significant impact on wasting among children, while there was a negative impact in 2008 that was significant for those in the middle and richer index. The level of education is also negative and significant for all the years under consideration and the pooled dataset, except in 2003 where it is negative but not significant. While the age of the mother is not significant for all the years considered and the pooled data, it showed a negative relationship with wasting in 2008 and 2013. The age of the child is both significant and negative for all the years considered and the pooled dataset, while the household size, incidence of diarrhea, and the burden of an extra child do not have any significant impact on child wasting. Children who have had fever are most likely to suffer from wasting, and as their body mass index increases, the rate of wasting will decrease.

Table 5: Results of the mixed-effects probit regression: Incidence of child malnutrition (wasting)

Wasting	**2003**	**2008**	**2013**	**Pooled**
Wealth index				
Poorer	0.01	-0.05	-0.03	-0.03
	(0.08)	(-1.12)	(-0.85)	(-1.14)
Middle	-0.04	-0.17***	-0.09	-0.10***
	(-0.42)	(-3.35)	(-1.88)	(-3.40)
Richer	0.07	-0.14*	-0.10	-0.06
	(0.65)	(-2.33)	(-1.81)	(-1.62)
Richest	0.13	-0.03	-0.14*	0.01
	(0.98)	(-0.36)	(-1.97)	(0.21)
Educational level				
Primary	-0.11	-0.19***	-0.09*	-0.22***
	(-1.32)	(-4.54)	(-2.33)	(-8.68)
Secondary	-0.18	-0.33***	-0.17***	-0.29***
	(-1.71)	(-6.12)	(-3.55)	(-9.38)
Higher	-0.15	-0.48***	-0.25**	-0.39***
	(-0.68)	(-4.17)	(-2.77)	(-6.34)
Age	0.01	-0.00	-0.00	0.00
	(1.13)	(-0.32)	(-0.24)	(0.15)
Childageyr	-0.11***	-0.09***	-0.16***	-0.12***
	(-4.62)	(-8.58)	(-17.59)	(-18.43)
Hhsize	-0.01	0.00	0.00	0.00
	(-1.26)	(0.68)	(1.50)	(0.70)
Genhhd	0.01	-0.07	-0.09	-0.11**
	(0.07)	(-1.15)	(-1.87)	(-3.17)
Healthvisit	0.04	-0.05	-0.01	-0.03
	(0.57)	(-1.37)	(-0.33)	(-1.49)
Bmi	-0.02	-0.02***	-0.02***	-0.02***
	(-1.91)	(-4.43)	(-5.84)	(-7.63)
Vaccine	-0.09	-0.08*	-0.04	-0.05**

	(-1.30)	(-2.47)	(-1.13)	(-2.71)
Childgender	-0.02	-0.06*	-0.09***	-0.07***
	(-0.26)	(-2.11)	(-3.76)	(-3.90)
Childiarrhea	0.14	0.08	0.02	0.03
	(1.71)	(1.68)	(0.38)	(1.15)
Childfever	0.08	0.11**	0.10**	0.04
	(1.22)	(2.69)	(2.66)	(1.77)
Womenjob	-0.11*	-0.05	-0.02	-0.05***
	(-2.51)	(-1.70)	(-0.60)	(-3.31)
Childburden	-0.09	0.02	-0.07	-0.04
	(-0.56)	(0.34)	(-1.20)	(-0.99)
Constant	-0.74**	-0.27*	-0.05	-0.15*
	(-3.20)	(-2.40)	(-0.53)	(-2.26)
Random effect	0.03	0.22***	0.21***	0.09***
Cluster number	(1.35)	(9.72)	(10.57)	(11.02)
N	3385	13573	16008	32966

Source: Authors' calculations based on 2003, 2008, and 2013 Demographic and Health Survey (DHS) data for Nigeria.

Note: *t* statistics in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). See Table 1 for variable descriptions.

5. Conclusions

This paper investigated the impact of household welfare and disease incidence on child nutritional status in Nigeria using the 2003, 2008, and 2013 children recode data of the DHS for Nigeria. Welfare was proxied using the wealth index of the DHS that captures wealth over time. The descriptive results show that malnutrition among under-5 children varies across the different wealth index levels with 50 percent and 35 percent of the children under-5 in the poorest and poorer index stunted and underweight, respectively. The results from the analysis in the paper show that there is strong link between household welfare and nutritional level, especially among women and children. Results of the mixed-effects probit model also show that a child from a household with lower welfare is more likely to be susceptible to stunting and underweight. Household welfare level that is above average motivates increased nutritional level among women and children in households and reduces the incidence of disease. Investment in education and better dietary diversity among household members, especially women and children, would increase household productivity and nutrition. The results from our analysis also indicate that there is a need for proactive nutritional policies that would incorporate avenues for sustainable and improved household welfare in Nigeria. There is also a need to increase the prospects of dietary diversity among rural households by encouraging increased diversity of agricultural crops produced in those areas. Dietary diversity could also be increased by increased nutrition education among households especially those in rural areas. In response to increasing the number of women and children that do not have access to health care facilities, there is a need for increasing the number of health facilities and the quality of services that they provide. Policies should also be targeted towards providing affordable health insurance to both women and children in rural areas. Finally, since the welfare status of households' impacts nutrition and incidence of diseases with varying degree of impact across the different geopolitical zones in Nigeria, there is a need for zone- and state-specific nutrition interventions to address child malnutrition and poverty, especially in the northern parts of the country where these incidences are higher.

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