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**Patterns and Trends of Child and Maternal Nutrition
Inequalities in Nigeria**

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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ABSTRACT

Despite the fact that nonincome dimensions of well-being such as nutrition and health are now placed on the global development agenda, substantial gaps remain in our knowledge about patterns and trends in nutrition inequalities in many developing countries. The main objective of this paper is to document a useful starting point for understanding the determinants of inequalities in nutritional status and provide some understanding of the proximate causes of inequalities in nutritional status as well as the factors responsible for inequalities in health and nutritional status of children and women in the policy debate. Using Nigeria as a case study and using data from the Nigerian Demographic and Health Survey, this paper measures and decomposes the patterns and trends of inequalities in child and maternal nutritional status in Nigeria. In particular, the paper decomposes observed nutritional inequalities into inequalities between and within demographic and socioeconomic groups to ascertain the relative contributions of the between-groups and within-group components of inequalities. To identify the most vulnerable groups in Nigeria, the paper also explores the prevalence of child and maternal malnutrition in Nigeria. The paper finds that within-group inequalities are the sources of most inequalities in the nutritional status of children and women in Nigeria. Inequalities between demographic and socioeconomic groups are less important. Child and maternal malnutrition are concentrated among the least educated households, the rural population, the north (in particular its Hausa ethnic group), and those who drink water from public wells. Malnutrition in Nigeria is a vicious cycle in that child malnutrition can be partly traced back to low birth weight (and therefore to maternal malnutrition). To interrupt this vicious cycle, the Nigerian government should take targeted and concerted actions that focus attention on addressing within-group inequalities. Intervention in the areas of primary healthcare, home-based caring practices, access to basic services (such as safe drinking water and good sanitation), education of women, and direct nutritional interventions for malnourished children seem the most appropriate.

Keywords: nutrition, inequality, Nigeria

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1. INTRODUCTION

The most common way to measure welfare is based on incomes or consumption levels. However, one of the several dimensions of well-being that has been relatively neglected in the past few decades is nutrition. “Adequate nutrition is instrumental in enabling people to earn a living, and to enjoy the fruits of their labors” (Deaton 1999, 1). Nutrition is one of the most critical veritable ingredients of labor productivity, and it increases human potentialities of all kinds (Perkins et al. 2001). Not only is nutrition central to well-being, but nutritional well-being is also a fundamental human right. Malnutrition currently accounts for about half of the 10 million deaths each year among under-five children in the developing world. Malnutrition is strongly associated with poverty because levels of malnutrition are higher in poor countries than in better-off countries (World Bank 2000).

Although the last three decades have witnessed a 20 percent reduction in the proportion of malnourished children in developing countries, about 160 million children under five years of age—almost one-third of the developing world’s children—are still malnourished (WHO 1999; Smith and Haddad 2000). It has been projected that under the most likely circumstances, about 135 million children under the age of five in developing countries will be malnourished by 2020 (Pinstrup-Andersen et al. 1999). Clearly, the first few years are the most crucial to the intellectual capacity and physical development of children and can promote their future productivity growth (Pinstrup-Andersen 2000; Smith and Haddad 2000). As adults, the ability of malnourished children to secure nutritional well-being for their own children may be greatly hampered, bringing about a vicious cycle of intergenerational poverty.¹ Without good nutrition, a person’s potential to escape from poverty is weakened due to lost time, lost labor, lost income, and the burden of healthcare costs. This explains why any attempt to reduce poverty, advance health equity, and improve well-being of poor people must primarily involve improved nutritional status.

To provide efficient and effective policy recommendations and interventions that advance health equity, enhance nutritional well-being of children, and promote the rights of children, it is necessary to first understand the levels of malnutrition and the disparities in nutritional status of children along socioeconomic groups (such as race or gender) or by geographical locations (such as rural or urban areas). This shows that “inequality decompositions are an effective tool in the positive analysis of inequality... that can be a first step in identifying the proximate causes of inequality” (Kanbur 2002a, 2). In essence, inequality decompositions of nutritional status of children must be taken as the starting point of identifying the areas of nutritional intervention that are highly relevant in ensuring the nutritional well-being of children (Wagstaff 2002; Booysen 2003; Wagstaff et al. 2001).

In light of the above, this paper has four objectives. The principal objective of the paper is to document the patterns of inequalities in nutritional status of children and women in Nigeria between and within demographic and socioeconomic groups in the country. This analysis will provide some understanding of the proximate causes of inequalities in nutritional status as well as the factors responsible for inequalities in nutritional status of children and women in the country. The second objective is to explore the prevalence of child and maternal malnutrition in Nigeria by different demographic and socioeconomic characteristics to identify the most vulnerable groups in Nigeria. The third objective is to ascertain whether there is any discernable relationship between levels of inequalities in child and maternal malnutrition and the prevalence of child and maternal malnutrition in Nigeria. The latter is important because of the focus in international and national development goals on average rates of malnutrition. For instance, the only nutrition-focused target of the Millennium Development Goals, which is the halving of underweight among under five children by 2015, is expressed only in terms of average rates (Gwatkin 2000). It is, therefore, of some interest to establish how average rates of malnutrition and inequalities in malnutrition compare within a country. The fourth objective is to

¹ For instance, women who were stunted in childhood are more prone to have low-birth weight babies.

ascertain the vicious/virtuous cycle of maternal and child nutritional status in Nigeria with the aim of determining whether child malnutrition is traceable to maternal malnutrition.

The focus on Nigeria is justified quite simply. Nigeria accounts for nearly one-fourth of Sub-Saharan Africa's poor; it is a region where the number of malnourished children is forecast to increase by more than 30 percent to reach 40 to 45 million by 2020 (WHO 1997; Pinstrip-Andersen et al. 1999). Moreover, more than 50 percent of all childhood deaths have undernutrition as an underlying factor in Nigeria (NPC/UNICEF 1998). Nutritional deficiencies contribute to the high rates of morbidity, mortality, and disability in Nigeria. Like almost all other developing countries in the world, Nigeria has committed itself to providing equitable access to health and nutrition care for all socioeconomic groups of people living in different geographical locations of the country. Nigeria has also committed itself to national food and nutrition policies through the establishment of the National Committee on Food and Nutrition and several Committees on Food and Nutrition at both state and local government levels to coordinate nutrition-related actions, which emphasize the socioeconomic and spatial rights to nutrition. Despite numerous nutritional policies introduced in Nigeria, substantial gaps remain in our knowledge about inequalities in the nutritional status of children and women. The implication of the latter is that the groups that are seriously affected by nutritional deficiencies may not be properly targeted by the various Nigerian nutrition policies.

Following this Introduction, Section 2 describes the methods and indicators employed in the paper. Section 3 explains the framework of analysis used to measure and decompose inequalities in the nutritional status of children and women in Nigeria. Section 4 briefly provides details about the data used for the analysis in the paper, the Nigerian Demographic and Health Survey (NDHS) of 2003. Section 5 presents the results of analysis carried out in the paper, elaborating intermittently on the implications of the most important findings in advancing equity in nutrition. Section 6 concludes with some policy recommendations for Nigerian nutrition policymakers and target setters.

2. METHODS

2.1. Measuring the Nutritional Status of Children

The indicators of nutritional status of children used in this paper (and available in the NDHS) are the height-for-age (H/A), weight-for-height (W/H), and weight-for-age (W/A) anthropometric indicators of nutritional status for under-five children. The anthropometric indicators are reputed to serve as a proxy to measure the quality of life for an entire population (Pradhan, Sahn, and Younger 2001). H/A is an indicator of a child's long-term or chronic nutritional status. It reflects linear growth achieved before and after birth of children, with its deficits' indicating long-term or chronic, cumulative effects of inadequate nutrition, health, or both, "especially protein-energy malnutrition, and sustained and recurrent illness" (Wagstaff and Watanabe 2000, 6). Low H/A, which is called "stunting," refers to a situation in which children are shorter than expected for their age and gender group in the reference population due to past chronic nutritional deficiency (Sahn and Stifel 2002). W/A is an anthropometric indicator that measures body mass in relation to age. Low W/A, which is called "underweight," represents a deficit in W/A, that is, a situation wherein children weigh less than expected considering their age. W/H is an anthropometric indicator that measures body mass in relation to body length and describes a recent and acute process that has produced a substantial weight loss, usually as a consequence of an acute or recent shortage of food, a recent severe disease within a short time span, or both. Low W/H, which is called "wasting," refers to a situation wherein a child has failed to achieve adequate weight for his or her height.

The determination of H/A, W/A, and W/H anthropometric indicators of nutritional status of a particular population of children, normally expressed as Z-scores, is usually carried out through the use of a standard reference population as a point of comparison. Z-score is a statistical measure of the distance from the median expressed as a proportion of the standard deviation, that is,

$$Z\text{-score} = \frac{(\text{Observed value}) - (\text{Median value of the reference value})}{\text{Standard deviation of the reference population}}$$

The standard reference population, as used by the NDHS, is the U.S. National Center for Health Statistics (NCHS) standard, which is recommended for use by the World Health Organization (WHO 1983). In conformity with the international standard based on previous precedents and for the purpose of comparisons with previous work, this paper analyzes the prevalence of child malnutrition in Nigeria by considering children with Z-scores below -2 standard deviations from the median of the NCHS reference population in terms of H/A, W/A, and W/H as stunted, underweight, and wasted, respectively. For instance, a child with a Z-score for H/A of -2.66 is considered stunted, whereas a child with a Z-score for H/A of -1.88 is not classified as stunted. The reason for favoring children with Z-scores below -2 standard deviations is that those scores convey information about the depth of malnutrition rather than simply whether a child was malnourished.

Further, children with Z-scores below -3 standard deviations from the median of the NCHS reference population in terms of H/A, W/A, and W/H are considered severely stunted, severely underweight, and severely wasted, respectively.

2.2. Measuring the Nutritional Status of Women

This paper uses body mass index (BMI), which is a measure of fatness/thinness, to assess the nutritional status of adult women. BMI, which is also known as Quetelet's Index, is defined as weight in kilograms divided by the square of height in meters. Unlike the nutritional status of children, the evaluation of nutritional status of women does not require a reference table from a well-nourished population. Normally, body weight is proportional to body height, and the BMI of well-nourished adult women ranges from 18.5 to 25.0. A BMI higher than 25.0 indicates obesity or what is sometimes called overnutrition. A BMI lower than 18.5 is considered to be an indicator of energy deficiency or low food

intake, which can be used to assess thinness or acute malnutrition among women. As recommended by WHO (1985), the 17.0 to 18.49 BMI range indicates mild malnutrition, 16.0 to 16.9 indicates moderate malnutrition, and all values less than 16.0 indicate severe malnutrition. The preferred measure of acute malnutrition or wasting among women employed to analyze malnutrition prevalence among women in this paper is the cutoff point of 18.5 because it incorporates all three grades of mild malnutrition, moderate malnutrition, and severe malnutrition (Sahn and Stifel 2002).

It must be mentioned that the paper examines the patterns of nutritional status of women less intensively than those of children because the consequences of malnutrition for adult women are considered to be less severe than for children. Moreover, since the nutritional status of adults is likely to be determined earlier in their lives, there will be less scope for policy interventions to target eradication of malnutrition among adult women. Nevertheless, there are important reasons why it is highly desirable to analyze the nutritional status of adult women. First, the nutritional status of women can have serious consequences for their children's birth weights and for infant mortality, especially during pregnancy and lactation. Second, some studies have shown that there are economic and health consequences to being a malnourished adult (see, for example, Marini and Gagnolati 2003). Not only has low BMI been shown to have a negative effect on labor productivity, but also, in developing countries, a BMI lower than 18.5 has been associated with increased mortality risk.

3. MEASURING AND DECOMPOSING INEQUALITIES IN NUTRITIONAL STATUS OF CHILDREN AND WOMEN

The paper follows the argument of Pradhan, Sahn, and Younger (2001) and Deaton (1999, 2001) that inequalities in health and nutritional status must focus on pure inequalities in health and nutritional status, not the correlations between health or nutritional status and income/expenditure. In essence, the traditional approach of Wagstaff et al. (1991), Wagstaff et al. (2001), van Doorslaer et al. (1997), and Kakwani et al. (1997) was modified in that the paper orders well-being of children and women by nutritional status, not income levels, and describes the patterns of inequalities in nutritional status across this nutritional ordering².

Nevertheless, according to Deaton (1999), inequality in health and nutrition can be better understood by starting with income inequality and examining whether the theoretical and measurement structure of the latter can be transferred to the former. Therefore, it would be expected that measures of income inequality such as the range, share ratios, mean absolute deviations, coefficients of variation, Gini coefficients, Lorenz curves, and the Generalized Entropy (GE) class of inequality measures can be applied to the measurement of inequality in nutritional status³. However, unlike other measures of inequality, only the GE class of inequality measures satisfies the five standard criteria for measuring inequality, including the attractive property of being easily decomposable by subgroups.⁴ This paper makes use of a special case of the GE class of inequality measures, namely, the Theil L index, to measure and decompose indicators of nutritional status in children and women in Nigeria. The next subsection explores the Theil L index and how it can be decomposed by subgroups.

3.1. Decomposability and the Theil Inequality Measures

Decomposability

Decomposability implies that an inequality measure can be broken down into components or constituents. To satisfy the criterion of decomposability, an inequality measure needs to be easily decomposed between subgroups of a population in the distribution of a welfare variable. This is also called “groupwise decomposition.” In essence, decomposability is a property of an inequality measure that separates the variation in overall inequality into two parts: a within-group and a between-groups measure. “Within-group inequality is a weighted sum of the inequalities calculated for each of the groups. It reflects the

² For instance, based on Kakwani et al. (1997), Wagstaff et al. (2001) derive and use concentration indices to analyze malnutrition inequalities in Vietnam across income groups.

³ The range is computed as the difference between the richest and poorest people in the distribution of welfare indicator, divided by the mean to ignore the units of measurement. Share ratios are simply calculated by dividing the share of the richest by that of the poorest in a desired proportion. It measures the degree of inequality between two extremes of very poor and very rich. The share approach is a common measure of inequality that features prominently in the burgeoning literature such as World Bank and Human Development Reports. Mean absolute deviation is calculated as the summation of the absolute values in the difference between the mean and each data point on the welfare variable scale, divided by the total variable. The coefficient of variation is calculated as the ratio of standard deviation (or the square root of the variance) and the mean variable, indicating that what matters is relative inequality. The Gini coefficient, which is the most popular and frequently used measure of inequality, incorporates the more detailed shares data starting from the base across the whole distribution to capture inequality. The Lorenz curve is a theoretical cumulative distribution curve of welfare indicator to population based on the notion that individuals in a population are ranked from the poorest to the richest. Other inequality measures include variance, variance of logarithms, logarithmic variance, and the Atkinson set of inequality measures, among others.

⁴ The five criteria or general rules required for inequality measurement are (1) Anonymity (names do not matter), (2) Population Principle (population share is what matters), (3) Relative Welfare Principle (welfare share is what matters, not absolute amounts of welfare), (4) Dalton Transfer Principle (transferring welfare from a richer person to a poorer person should indicate a fall of inequality and vice versa), and (5) Decomposability (summation of within-group and between-groups inequality should be equal to total inequality). (For further elaboration on the criteria for inequality measurement, see Ray 1998; Litchfield 1999; Atkinson 1970; and Cowell 1995.)

inequality that exists ‘over and above’ mean difference across groups” (Kanbur 2002b, 1). Within-group inequality shows how much inequality is due to variations between individuals in each group. “Between-group inequality is inequality calculated on the total population when each welfare variable in a group is replaced by the mean of the welfare variable in that group” (Kanbur 2002b, 1). Between-groups inequality indicates how much inequality is due to differences in the average welfare of each group, that is, the average differences across the groups. The addition of the two is expected to give us the estimate of total inequality of the population. If inequality rises in each of the subgroups, the overall inequality will also increase and vice versa (for further information on inequality decomposition, see, for example, Bourguignon 1979; Cowell 1980; Shorrocks 1984; Deaton 1997; Jenkins 1995; and Litchfield 1999).

The number of groups in any grouping such as race, space, and gender affects the between-groups component. The subdivision of groups into many subgroups or divisions increases the between-groups component (Kanbur 2002a). Grouping a population into, say, 12 subgroups gives rise to a much bigger between-groups component than grouping them into, say, 2 subgroups. As mentioned above, inequality measures of the GE class are all decomposable into intuitively appealingly components of within-group inequality and between-groups inequality. The general formula of members of the GE class of measures is indicated as follows:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha} \left[\frac{1}{n} \sum_{i=1}^n \left(\frac{y_i}{\mu} \right)^\alpha - 1 \right], \quad (1)$$

where n is the number of individuals in the sample, y_i is the welfare variable of individual i , ($1, 2, \dots, n$), and μ is the sample mean of the welfare variable in question. The value of GE ranges from 0 to ∞ , with 0 representing an equal distribution or perfect equality (all welfare variables identical) and higher values indicating greater inequality. The parameter α in the GE class represents the weight given to distances between welfare variables at different parts of the distribution of the welfare variable and can take any real value. For lower values of α , GE is more sensitive to low-end inequality changes, and for higher values GE is more sensitive to upper-end inequality changes. The most common values of α used are 0, 1, and 2. The GE measures with parameter 0 will give us the Theil L measure of inequality, otherwise called the mean log deviation, as follows:

$$GE(0) = \frac{1}{n} \sum_{i=1}^n \ln \frac{\mu}{y_i} \quad (2)$$

The Theil L index is most sensitive to low-end inequality changes. Two types of decomposition are of interest: the decomposition of the level of inequality in any one year, that is, a static decomposition, and a decomposition of the change in inequality over a period of time, that is, a dynamic decomposition (Litchfield 1999). Since the paper is focused on the NDHS, the techniques for static decomposition are as follows:

Within-group Inequality

For the GE class of inequality measures, within-group inequality is expressed as follows:

$$I_w = \sum_{j=1}^k w_j GE(\alpha)_j, \quad (3)$$

$$w_j = v_j^\alpha f_j^{1-\alpha}$$

where f_j is the population share and v_j is the share of the welfare variable of interest (in this case, Z-scores for the anthropometric indicators of nutritional status in children) of each partition $j, j = 1, 2 \dots k$. To calculate within-group inequality using the Theil L index, equation 3 changed to the following:

$$\text{Theil L: } I_w = \sum_{j=1}^k f_j GE(O)_j. \quad (4)$$

This means that for the Theil L, I use population shares as the weights of the groups to derive within-group inequality.

Between-group Inequality

For the GE class, between-groups inequality, I_b , is measured by assigning the mean of the welfare variable of each partition j, μ_j , to each member of the partition and calculating as follows:

$$I_b = \frac{1}{\alpha^2 - \alpha} \left[\sum_{j=1}^k f_j \left(\frac{\mu_j}{\mu} \right)^\alpha - 1 \right]. \quad (5)$$

From the between-groups inequality formula of the GE class presented in equation 5, the between-groups inequality formula for the Theil L index is derived as follows:

$$\text{Theil L: } I_b = \sum_{j=1}^k f_j \ln \frac{\mu}{\mu_j} \quad (6)$$

Again, to derive between-groups inequality for the Theil L, equation 6 shows that population shares as the weights of the groups are used.

3.2. Consequence of Calculating Z-Scores for the Anthropometric Indicators of Nutritional Status Using the Theil L Index

An important measurement issue to mention is that there is a consequence of using the Theil L index as the preferred inequality measure adopted for measuring and decomposing inequalities in nutritional status across all children. The consequence is that a large number of the Z-scores for the anthropometric indicators of nutritional status of Nigerian children take on negative values. Since the Theil indices are usually defined over positive real values (Deaton 1997), it becomes somewhat implausible to measure and decompose inequalities in nutritional status across all children using the unadjusted values of the Z-scores. To tackle this challenge, the procedure of Pradhan, Sahn, and Younger (2003) and Sahn and Stifel (2002, 10)⁵ is followed by simply adding just more than the negative value of the smallest number to each Z-score.⁶ For example, adding eight to the value of the W/A Z-score for each child does not alter the rank ordering of children, producing almost the same information as the unchanged set of W/A Z-scores. More importantly, Theil L index was never really designed for nutritional measures because it contains a log transformation, which cannot cope with negative numbers. This implies that the procedure employed in the paper might actually be introducing a small bias to the results, and this represents a limitation of the study. Although this procedure lowers the level of inequality, as measured by the Theil L index, the shares of inequality attributable to within-group and between-groups inequality are slightly affected (Pradhan, Sahn, and Younger 2003).

⁵ The authors encounter this problem while decomposing asset indices for African countries.

⁶ Please note that this procedure is employed for the decomposition of inequality in nutritional status across all children and not for the decomposition of inequality among only malnourished children. This is because the latter, which is the most common inequality decomposition employed by analysts (for example, Wagstaff and Watanabe 2000; Sahn and Stifel 2002) by considering only children with -2 standard deviations below the median (-2 Z-score) as the cutoff point below which children are classified as malnourished, takes on only negative Z-score values for all children.

Inequality is a complex and multifaceted phenomenon. Since nutritional inequality is influenced by the nutritional status of individuals and households, and because nutritional status itself is affected by so many other factors, the study of determinants of inequality and their decomposition is largely descriptive. The inferences of causation that can be drawn from such decompositions are merely suggestive.

4. DATA: THE NDHS

The data used for the analysis in this paper were obtained from the NDHS of 2003. The Demographic and Health Survey is part of a worldwide survey program funded by the United States Agency for International Development and implemented by Macro International, Inc.⁷ Since 1984, the Demographic and Health Survey program has conducted more than 100 nationally representative household surveys in more than 50 countries. The Demographic and Health Survey covers many health and nutrition issues, from fertility and family planning to nutrition and food. In Nigeria, the Demographic and Health Survey was conducted first in 1990; in 1999, on the eve of the new democratic dispensation; and then again in 2003. The NDHS, which is used for this paper, was conducted in a comparable fashion, which makes it a reliable data source, following a set of detailed and common procedures in all 36 states of the federation and the Federal Capital Territory. Both urban and rural areas were surveyed. Macro International, Inc. provided technical support in data processing and reporting.

The NDHS collected information about basic household socioeconomic characteristics, fertility, family planning, infant and child mortality, maternal mortality, and nutritional status of mothers and children. Other information collected includes household access to services (safe water, sanitation, and electricity), utilization of basic health and education services, mother's education, and knowledge of treatment of common child illnesses. Despite the many advantages of the Demographic and Health Survey, one of its limitations is the absence of an income or expenditure variable, which is generally regarded as an important measure of welfare. Although the Demographic and Health Survey data lack income/expenditure data, the advantage of the data source is that it provides health and nutrition indicators nationally and in urban and rural areas separately. Moreover, Demographic and Health Survey data are estimated using common methodology and comparable data sources.

The survey was designed to produce representative regional (domain) and rural-urban (strata) estimates. By stratifying the sample into rural and urban areas in two stages, the NDHS was structured to produce precise and reliable estimates of different variables for the rural and urban areas (strata) of Nigeria as well as for the different regions (sampling domains) of Nigeria. The census enumeration areas were the primary sampling units.

A listing of all households in each selected enumeration area was then conducted. One in every five households listed in the primary sampling stage was selected for interview at the second sampling stage. The combination of probability proportionate to size sampling at the primary sampling stage and a fixed sampling rate at the second sampling stage provided a roughly self-weighting sample design. In essence, the Demographic and Health Survey program is designed for typical self-weighted samples at both rural and urban areas.

The paper takes advantage of the anthropometric component included in the NDHS, in which under-three children and their mothers were weighed and measured. The original anthropometric data had a sample size of 6029 children. Over 4000 children under five years have complete and plausible anthropometric data. This paper focuses on 1,456 children under three years of age for whom plausible data were available for the analysis of H/A and W/A anthropometric indicators. For the analysis of the W/H anthropometric indicator, the paper focuses on 1,583 children under three years of age for whom reasonable data were gathered. This implies that older children above three years of age were not considered in the analysis. This is a meaningful focus, as there is little potential for catch-up growth after the age of three years (Pradhan, Sahn, and Younger 2003). Moreover, Pinstrup-Andersen (2000) argues that most growth faltering, resulting in underweight and stunting, occurs within a relatively short period—from before birth until about two years of age. Hence, it can be argued that the results presented in this paper using children under three are broadly representative of overall and long-run inequality in health and nutrition among children. For the analysis of the BMI of women, the sample pool of women was taken from an original sample size of 7620. The paper focuses on 2,538 women aged 15 to 49 who had a birth in the three years prior to the survey, who were not pregnant at the time of the interview, and whose children under three years of age were eligible to be measured and weighed.

⁷ See <http://www.measuredhs.com>.

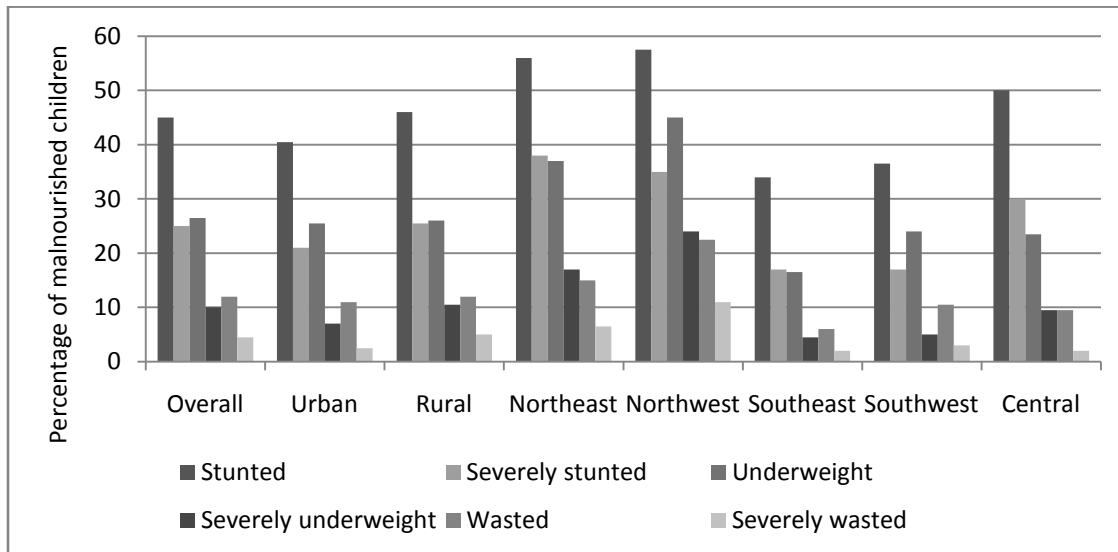
5. RESULTS AND DISCUSSION

To identify the most vulnerable groups in Nigeria, this section starts with an analysis of the prevalence of child malnutrition by demographic and socioeconomic characteristics in Nigeria using the three commonly used anthropometric indicators: H/A (stunting), W/H (wasting), and W/A (underweight). The section continues with the analysis of the prevalence of malnutrition among women aged 15 to 49 by demographic and socioeconomic characteristics in Nigeria using BMI. The section then presents the results of the decompositions of the three anthropometric indices of nutritional status of children in the selected sample plus the BMIs of women by different demographic and socioeconomic groups. The Theil L measure of inequality is used for these decompositions. The inequality decompositions are also carried out only for malnourished children. The section then examines the relationship between the prevalence of child malnutrition and inequalities in child malnutrition in Nigeria. The section also briefly examines the relationship between the three anthropometric indicators of child malnutrition used, as well as the relationship between the inequalities of these anthropometric indicators of child malnutrition.

5.1. The Prevalence of Child Malnutrition in Nigeria

Figures 1 to 8 present the prevalence of child malnutrition in Nigeria by place and region of residence of children, location of children, educational attainment of mothers of children, sex of the household head, sex of child, ethnic groups in Nigeria, source of drinking water, and child's age. From the selected sample pool, almost half of all children under three in Nigeria are stunted, whereas a little more than one-quarter are severely stunted, indicating chronic malnutrition, food insecurity, and/or frequent illnesses. About 13 percent of children are wasted, whereas a little more than 5 percent of children are severely wasted, both indicating an acute or recent shortage of food and/or severe disease within a short time span. A total of 27.5 percent of children are underweight, whereas about 11 percent are severely underweight, representing a shortfall in W/A (a combination of acute and chronic malnutrition).

Figure 1. Prevalence of child malnutrition by residence, Nigeria



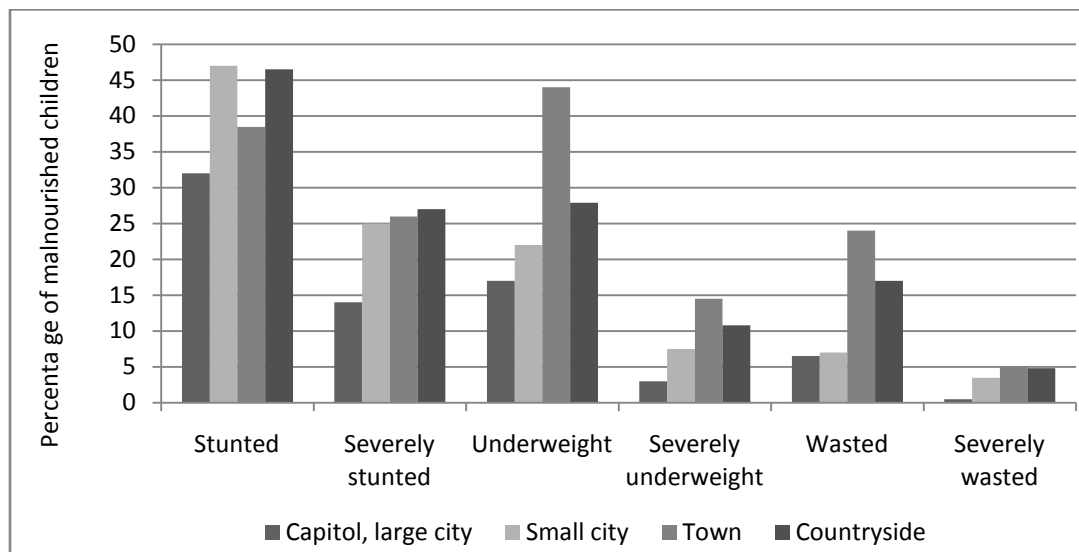
Source: Author's calculations from the Nigerian Demographic and Health Survey.

Furthermore, malnutrition, in terms of stunting, wasting, and underweight, is more prevalent among children in rural areas than those in urban areas (Figure 1). Malnutrition, in terms of stunting, wasting, and underweight, is concentrated among the children living in the Northeast and Northwest

regions of Nigeria, whereas the Southeast region has the lowest percentage of malnourished children. For instance, only about 5 percent and 3 percent of children in the Southeast region are severely underweight and severely wasted, respectively. The corresponding figures are five times and four times as high, respectively, among children in the Northwest region of Nigeria (Figure 1). The urban–rural and regional disparities in the prevalence of child malnutrition in Nigeria are consistent with the Nigerian situation in which many of the underlying and basic determinants of nutritional status such as safe water supply, adequate sanitation, healthcare, and potential resources available in the community are much worse off in the rural areas than in the urban areas and in the Northern regions of Nigeria than in the Southern regions. In fact, the political, economic, and sociocultural factors, which translate potential resources in the community into actual resources for food security, care, and healthy environment, are more favorable in the urban areas and Southern regions of Nigeria than in the rural areas and Northern regions, respectively.

Malnutrition, in terms of stunting, wasting, and underweight, is less prevalent among children whose locations are large capital cities compared with those whose locations are small cities, towns, or the countryside.⁸ The prevalence of underweight and wasting is highest among children dwelling in Nigerian towns. The levels of underweight and wasting prevalence among children in the countryside and small cities of Nigeria closely follow those of Nigerian towns, in that order. Although stunting prevalence tends to be highest and similar among children in small cities and the countryside (47 percent), the prevalence of severe stunting falls somewhat from countryside through towns and small cities to large capital cities (Figure 2). The explanations for Figure 1 also apply here in that determinants of nutritional status are much better off in large capital cities than in other locations in Nigeria.

Figure 2. Prevalence of child malnutrition by location, Nigeria



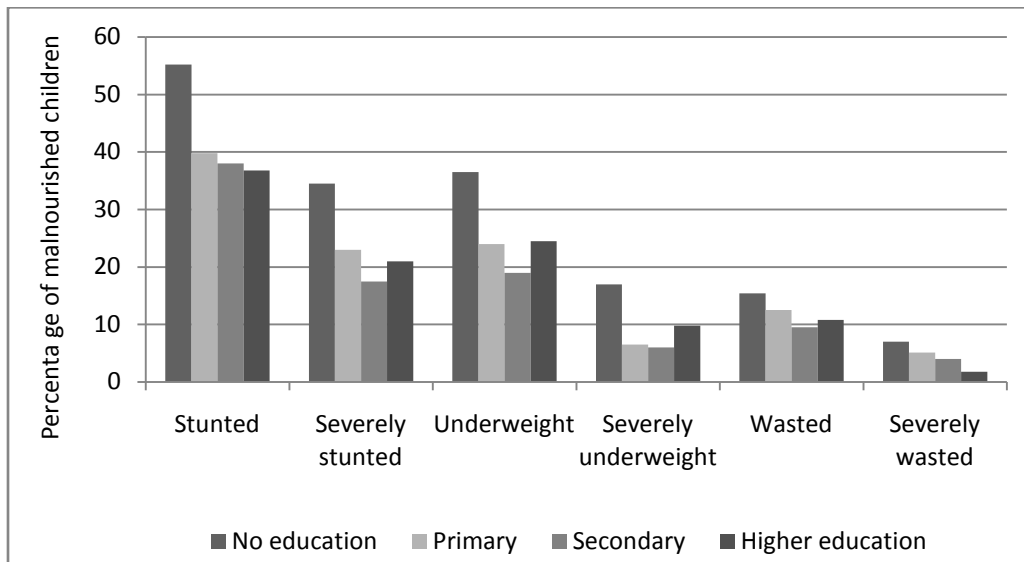
Source: Author’s calculations from the Nigerian Demographic and Health Survey.

Differentials in children’s malnutrition levels by their mothers’ education levels are very large (Figure 3). The prevalence of malnutrition, as measured by any of the three indicators, is much higher among children whose mothers have had no education than among those whose mothers have had some

⁸ Please note that location is used to further disaggregate the analysis of prevalence of malnutrition among Nigerian children. The same observations were used for rural areas and the countryside. Small cities and large capital cities in Nigeria can be categorized as urban areas. In the case of Nigerian towns, some of them can be classified as rural areas, whereas some can be classified as urban areas, in terms of the population of persons living in them. This is because in Nigeria, places with populations of less than 20,000 persons constitute rural areas, whereas places with populations of 20,000 or more persons constitute urban areas.

education. Stunting, in particular, illustrates that the higher the education of mothers, the lower is the prevalence of stunting among their children. However, the prevalence of underweight and wasting is higher among children whose mothers have higher education than among those whose mothers have secondary education. Although the latter is in concordance with the findings of NDHS, it does not correlate with the nutrition literature that tends to emphasize that the higher the education of mothers, the lower is the prevalence of malnutrition, as measured by any of the three anthropometric indicators, among their children (Marini and Gragnolati 2003). The simple reason one can adduce to the findings in Figure 3 is that there are very small observations of women with higher education (65) as opposed to observations of women with other educational attainments.

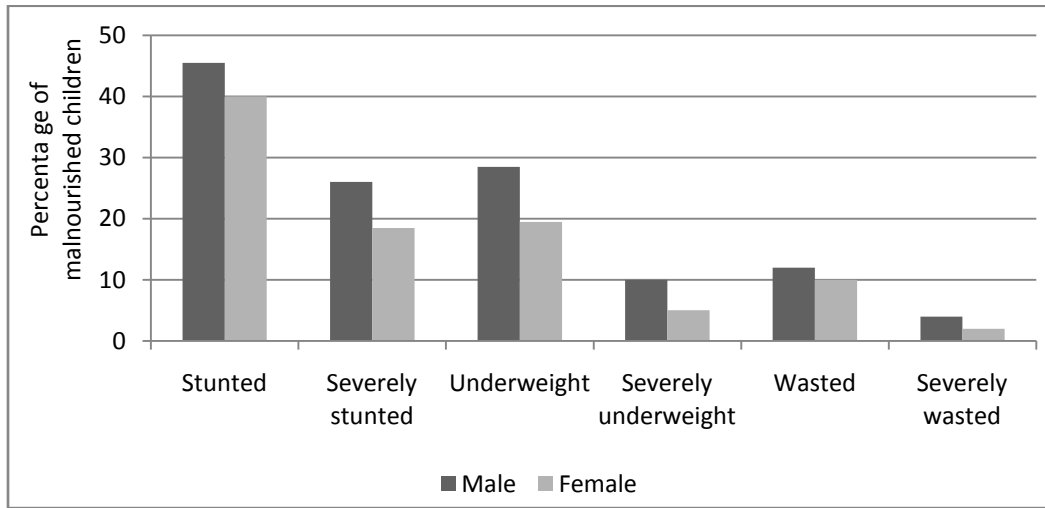
Figure 3. Prevalence of child malnutrition by education of mothers, Nigeria



Source: Author's calculations from the Nigerian Demographic and Health Survey.

Figure 4 displays the prevalence of child malnutrition by the sex of the household head. It is clear from Figure 4 that the prevalence of child malnutrition, in terms of stunting, underweight, and wasting, is higher among children living in male-headed households than among those living in female-headed households. For instance, although the prevalence of stunting is 46 percent among children living in male-headed households, the corresponding figure is 40 percent among children living in female-headed households.

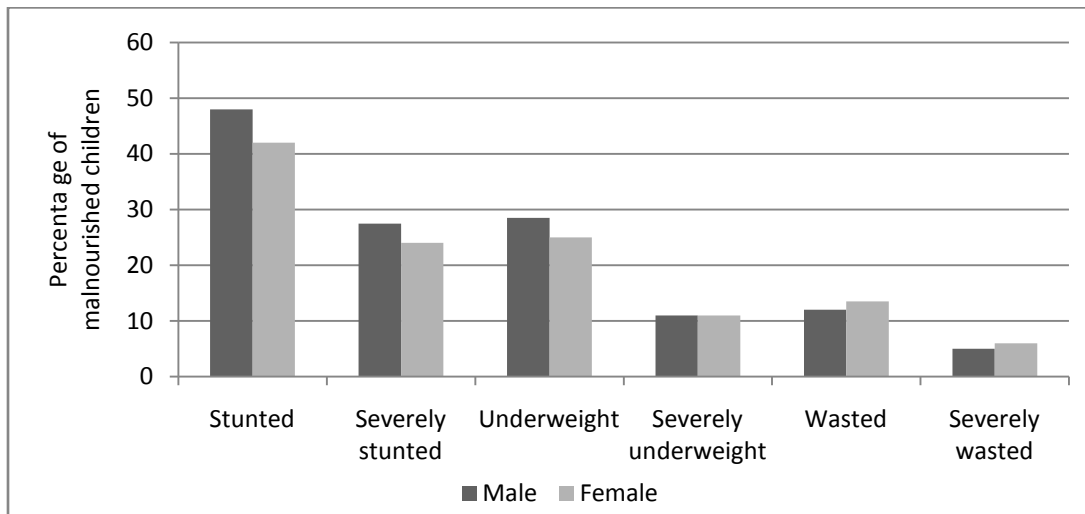
Figure 4. Prevalence of child malnutrition by sex of household head, Nigeria



Source: Author’s calculations from the Nigerian Demographic and Health Survey.

Turning to Figure 5, it is evident that although the prevalence of stunting and underweight tends to be higher among male children than among female children in Nigeria, the prevalence of wasting is slightly higher among female children than among male children in Nigeria. These results run counter to the prevailing belief that female children are generally more malnourished than male children. Although it is not clear why male children in Nigeria are more likely to be stunted and underweight than female children, this finding might not be unconnected with the prevailing nutritional policy in Nigeria that focuses greater attention on female children.

Figure 5. Prevalence of child malnutrition by sex of child, Nigeria

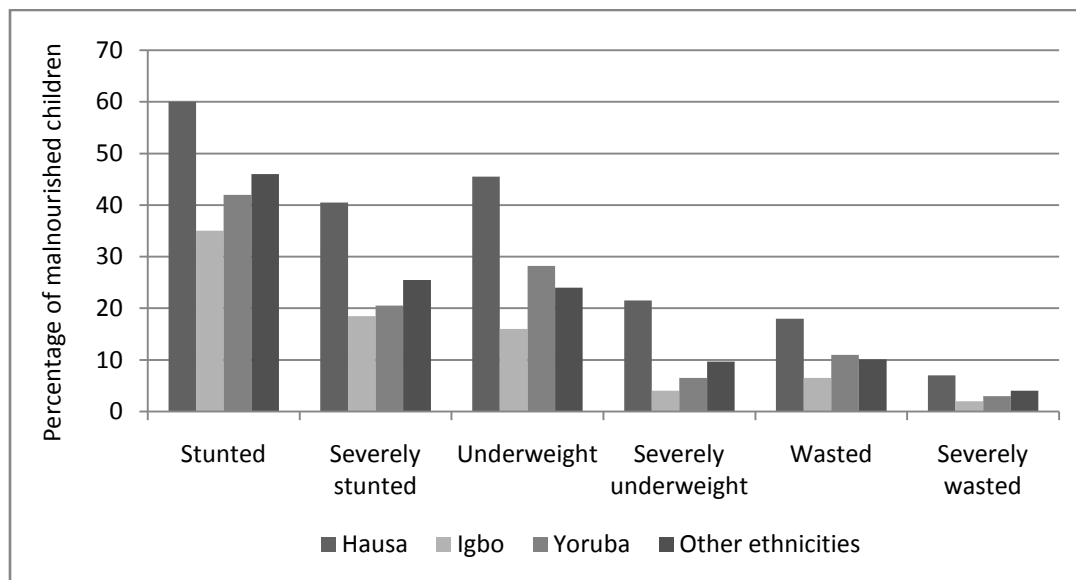


Source: Author’s calculations from the Nigerian Demographic and Health Survey.

Figure 6 displays the percentage of stunted, wasted, and underweight children among ethnic categories in Nigeria. If we consider the three major ethnic groups in Nigeria, Figure 6 shows that the prevalence of child malnutrition, in terms of stunting, wasting, and underweight, is highest among children of the Hausa ethnic group, followed by those of the Yoruba ethnic group, whereas children of the

Igbo ethnic group have the lowest malnutrition rates. These results confirm the existence of a very marked difference in nutritional status of children among different regions in Nigeria, as the Hausas belong to the Northeast and Northwest regions of Nigeria, whereas the Igbos and the Yorubas belong to the Southeast and Southwest regions, respectively. There are marked differences in sociocultural factors that determine nutritional status among Hausa, Igbo, and Yoruba. For instance, many Hausa women in the Northern regions of Nigeria go through early and arranged marriages at tender ages with little or no education and decisionmaking in the choice of marriage partner, and most of them are women in “purdah” who may not be allowed to visit health facilities for their care and the care of their children. These factors, which are rare among Igbo women but sometimes happen among Yoruba Muslim women, are among the most important driving forces of child and maternal malnutrition in northern Nigeria. Furthermore, as shown in Figure 6, the prevalence of stunting among other, smaller ethnicities in Nigeria is lower than that among Hausa children but higher than that among Yoruba and Igbo children. However, although the prevalence of underweight and wasting among Yoruba children is higher than that of smaller ethnicities in Nigeria, the latter are more severely underweight and severely wasted than the former.

Figure 6. Prevalence of child malnutrition by ethnicity, Nigeria



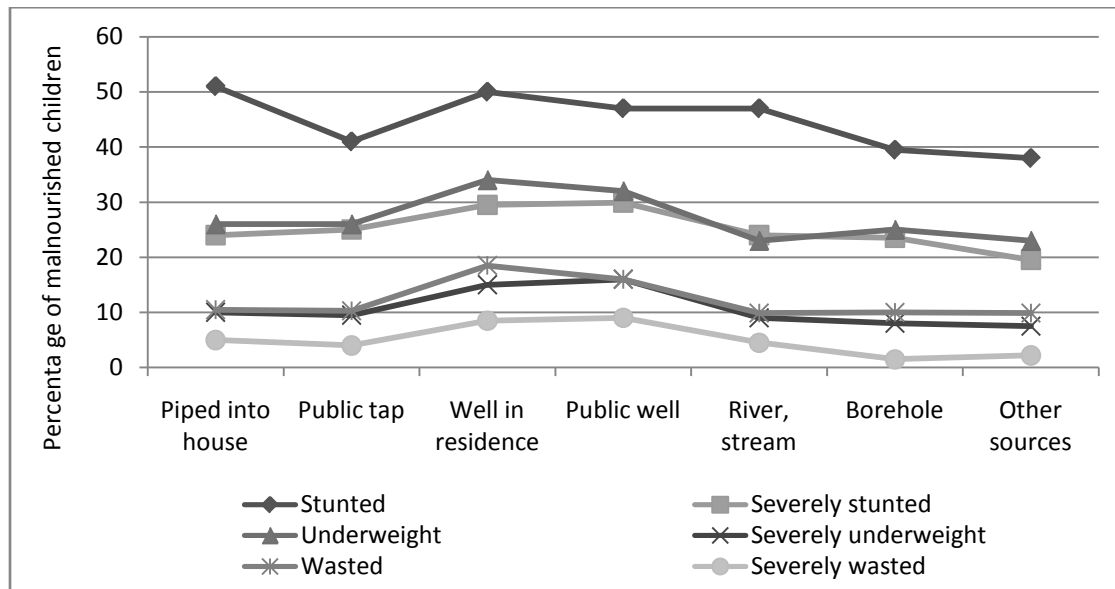
Source: Author’s calculations from the Nigerian Demographic and Health Survey.

Figure 7 shows the percentage of malnourished children according to the source of drinking water. It is evident from Figure 7 that safe drinking water is not regarded as an economic good as well as a social good in Nigeria in that there are high percentages of stunted, underweight, and wasted children drinking water from all the sources of drinking water. For instance, the lowest percentage of stunted children (40 percent) is observed among children who drink water from boreholes, whereas the lowest percentages of underweight children (22 percent) and wasted children (10 percent) are observed among children who drink water from other sources.⁹ Furthermore, children who drink water from wells in residence and public wells seem to be more stunted, wasted, and underweight than children who drink other sources of drinking water. This is not surprising in the Nigerian case because well water is not treated and sanitation is not respected, particularly as it relates to public wells, which are regarded as a

⁹ All the other sources of water recorded in the Nigerian Demographic and Health Survey are grouped into “Other sources” in Figure 7 because of their very small observations. These other sources of water include surface water, springs, ponds, lakes, dams, rainwater, tanker trucks, tanker vendors, and bottled water.

common property resource for the poorer segments of the Nigerian population.¹⁰ The latter perhaps accounts for public wells' being worse than rivers/streams in Nigeria.

Figure 7. Prevalence of child malnutrition by source of drinking water, Nigeria

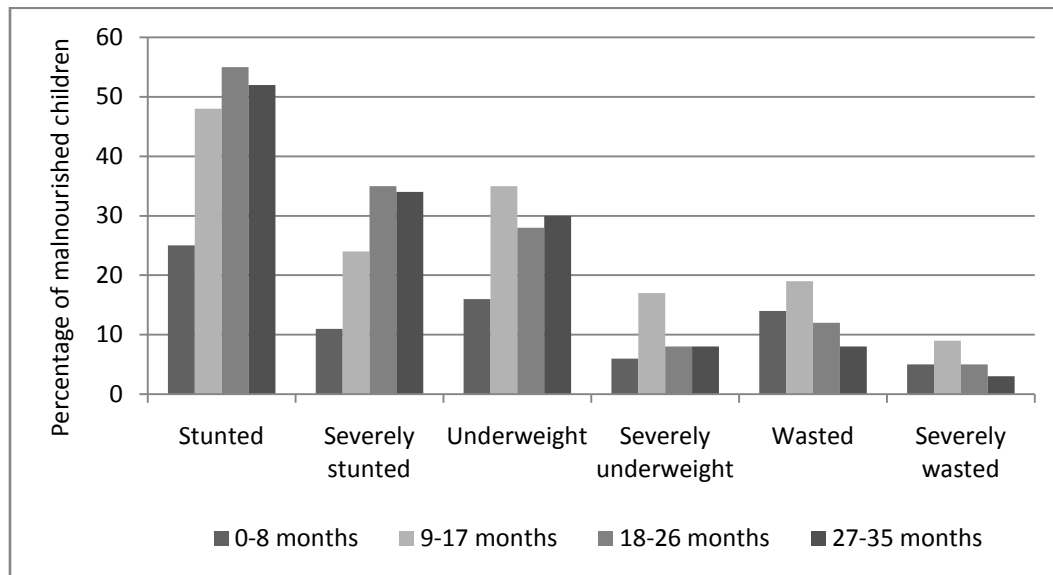


Source: Author's calculations from the Nigerian Demographic and Health Survey.

Figure 8 presents the prevalence of child malnutrition in Nigeria by child's age. Children aged 18 to 26 months tend to be more stunted and severely stunted, followed by children aged 27 to 35 months and those aged 9 to 17 months, respectively. Children aged 0 to 8 months have the lowest prevalence of stunting rates. However, for the underweight rates, children aged 9 to 17 months suffer more than other children, followed by children aged 27 to 35 months and 18 to 26 months, with children aged 0 to 8 months having the lowest underweight rates. Again, the prevalence of wasting is highest among children aged 9 to 17 months, followed by those aged 0 to 8 months, 18 to 26 months, and 27 to 35 months, in that order. According to the nutritional literature, malnutrition is a cumulative phenomenon, and hence malnutrition rates, as measured by the three indicators (stunting, wasting, and underweight), ought to increase with children's ages. Although the results in Figure 8 do not fully justify the latter, the prevalence of stunting—the most popular anthropometric indicator—increases until the age of 26 months. Malnutrition is, therefore, higher when it is most harmful to the child—in other words, during the first months of life. This is because children's brains grow most rapidly in early childhood and also because they are more vulnerable since their immune systems are not yet fully developed. The largest increase in malnutrition occurs between 6 and 24 months, while children are being weaned (WHO 1999). The weaning period, when infants make the transition from being fed exclusively with breast milk (which provides all of the nutrients and antibodies needed by the infants) to a diet of solid and liquid foods (often contaminated and of poor quality), is a critical period for babies' nutritional status.

¹⁰ This can be likened to the tragedy of the commons.

Figure 8. Prevalence of child malnutrition by child's age, Nigeria



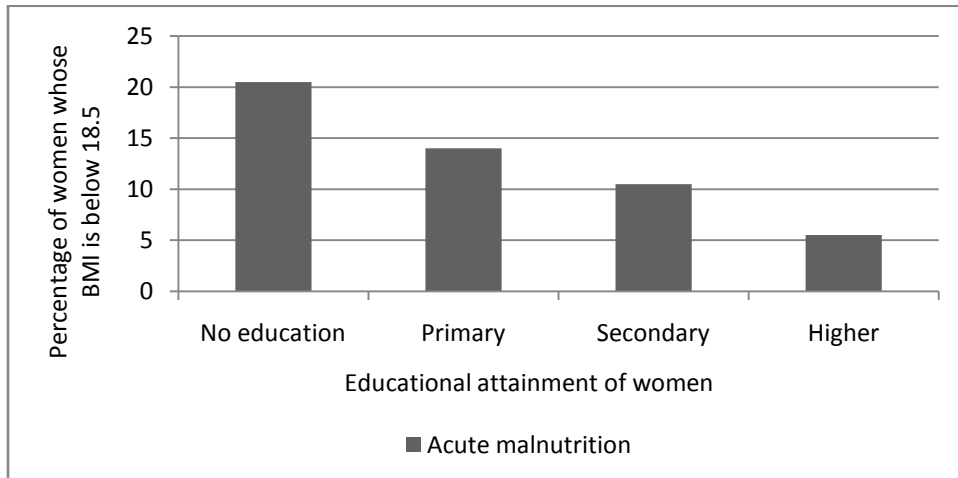
Source: Author's calculations from the Nigerian Demographic and Health Survey.

5.2. The Prevalence of Malnutrition among Women Aged 15 to 49

Figures 9 to 13 present the results of malnutrition prevalence among women in Nigeria. Malnutrition is less prevalent among women in the urban areas than among those residing in rural areas. As with child malnutrition, malnutrition prevalence among women is concentrated among women living in the Northeast and Northwest regions of Nigeria, whereas the Southeast region has the lowest percentage of malnourished women. Although only about 5 percent of women in the Southeast region are malnourished, the corresponding figures are five times and four times as high among women in the Northeast and Northwest regions, respectively. This shows that child malnutrition can be partly traced back to low birth weight (and, therefore, to maternal malnutrition). The incidence of low birth weight not only is an important indicator of the prospects for child survival but also indirectly indicate the nutritional status of mothers. According to UNICEF/Nigeria (2001), the highest incidence of low birth weight is observed in Adamawa state, followed by Niger, Sokoto, and Bauchi states, all in the Northern region of Nigeria. Abia state in the Southeast region of Nigeria has the best birth weight record, with 96 percent of the babies being of normal weight. These disparities show that children with low birth weights are more prone to grow and develop into malnourished women.

Malnutrition is more prevalent among women whose locations are in the countryside than among those located in large capital cities in Nigeria. This implies that the synergistic interactions among the determinants of nutritional status (immediate, underlying, and basic determinants) are more favorable in large capital cities of Nigeria than in other locations.

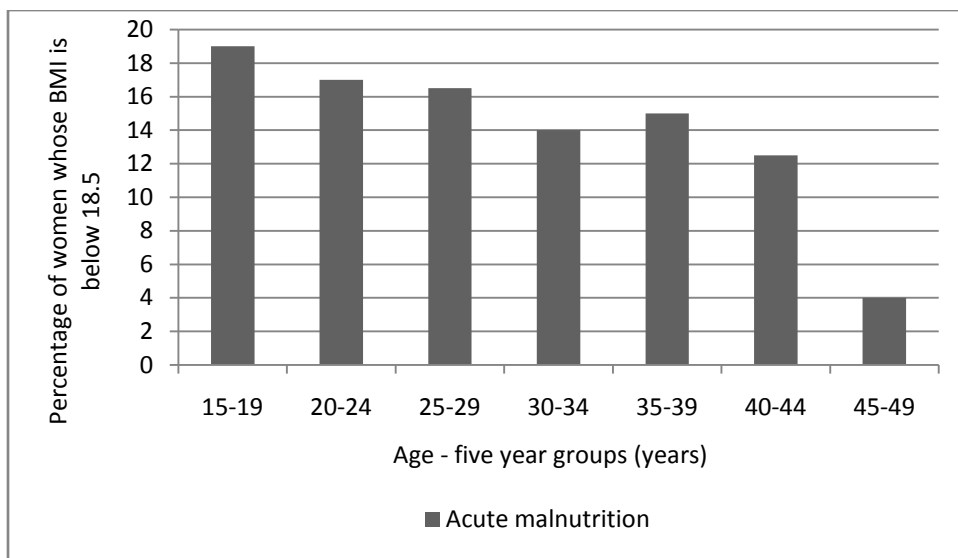
Figure 9. Malnutrition prevalence of women by education, Nigeria



Source: Author’s calculations from the Nigerian Demographic and Health Survey.
Note: BMI = body mass index.

Figure 9 displays malnutrition prevalence among women in Nigeria by education. The prevalence of malnutrition decreases with increasing educational attainment of mothers, from 6 percent among women who have attained higher education to 21 percent among those who have had no education. The results in Figure 9 show that educated, literate women are far more likely to take the actions necessary for their own nutritional well-being and good childcare practices for their children in Nigeria. In Nigeria, education and knowledge not only are the keys to female economic advancement but also provide women with greater levels of resources for their own care and well-being as well as those of their children. In Nigeria, the low status of women due to sociocultural factors including gender relations and women’s limited education hinders their ability to make decisions about reproductive health and nutritional matters. The reinforcing effects of these factors lead to higher malnutrition rates among less educated women in Nigeria.

Figure 10. Malnutrition prevalence of women by age, Nigeria

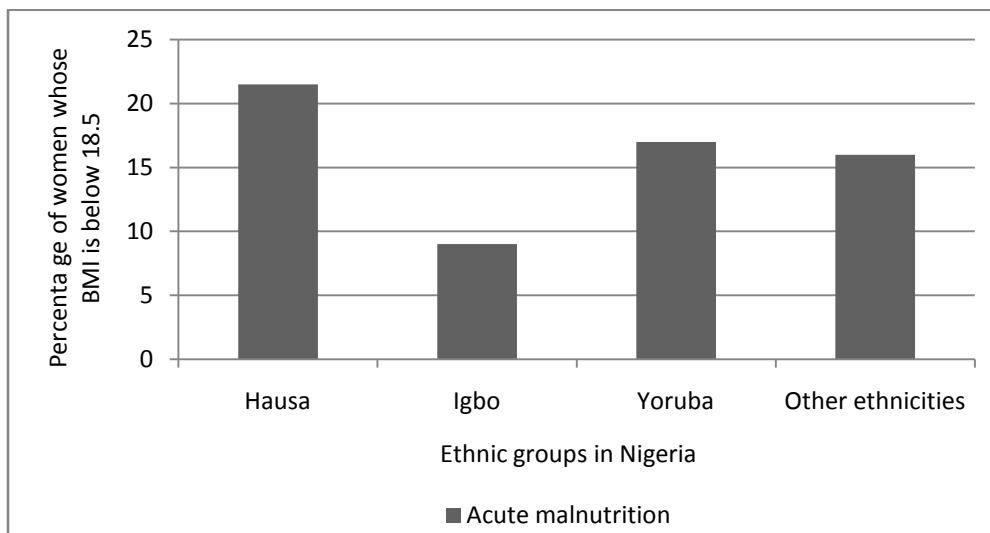


Source: Author’s calculations from the Nigerian Demographic and Health Survey.

As Figure 10 shows, the prevalence of malnutrition among women tends to fall as the age of women rises (except for women aged 30 to 34). This is not surprising in the case of Nigeria as young women who marry, for instance, between the ages of 15 and 19 and start childbearing are still children themselves who would not have received enough education leading to a lack of job opportunities, with acute malnutrition's being the end product.

Figure 11 shows the prevalence of malnutrition among women, by ethnicity, in Nigeria. Although the prevalence of malnutrition is lowest (9 percent) among Igbo women, it is highest among Hausa women, and it is slightly higher among Yoruba women than women from other ethnic groups. As explained in the child malnutrition discussion, the marked differences in sociocultural factors that determine nutritional status among Hausa, Igbo, and Yoruba could be attributable to the high prevalence of malnutrition among Hausa women. For instance, many Hausa women in the north of Nigeria go through early and arranged marriages at tender ages with little or no education and decisionmaking in the choice of marriage partners, and most of them are women in purdah who may not be allowed to visit health facilities for their care and the care of their children. These factors are among the most important driving forces of child and maternal malnutrition in northern Nigeria.

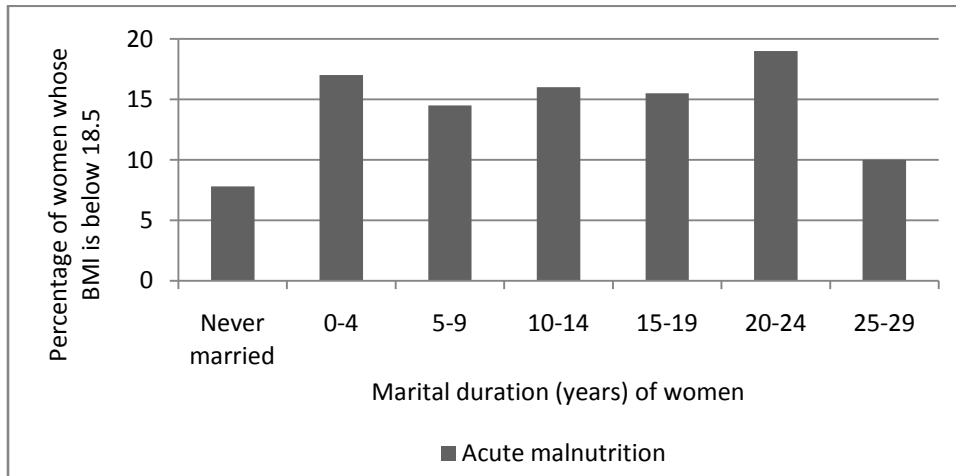
Figure 11. Malnutrition prevalence of women by ethnicity, Nigeria



Source: Author's calculations from the Nigerian Demographic and Health Survey.

Figure 12 presents the results of malnutrition prevalence among women, by marital duration, in Nigeria. Although malnutrition prevalence tends to be lowest among women who have never married before, women who have been married for 20 to 24 years have the highest prevalence of malnutrition, followed by those whose marital durations are 0 to 4 years and 10 to 14 years, respectively. The patriarchal nature of Nigerian society in which men tend to be social superiors to women in making important decisions that relate to the health, nutrition, and well-being of all members of the family might be responsible for the low malnutrition prevalence observed among women who have never married before. This is because women who have never married before might be experiencing social change and personal decisionmaking about determinants of nutritional status such as which types of food to eat, which levels of schooling and professional training to attain, and so forth.

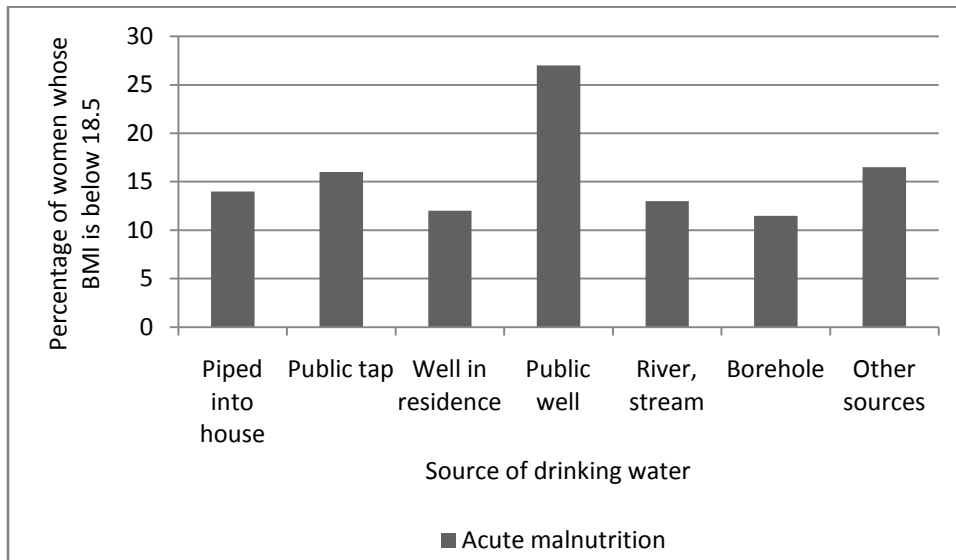
Figure 12. Malnutrition prevalence of women by marital duration, Nigeria



Source: Author’s calculations from the Nigerian Demographic and Health Survey.

From Figure 13, it is clear that malnutrition prevalence is highest among women whose source of drinking water is public wells. The explanation made in the child malnutrition discussion is also applicable here.

Figure 13. Malnutrition prevalence of women by source of drinking water, Nigeria



Source: Author’s calculations from Nigerian Demographic and Health Survey

5.3. Measuring and Decomposing Inequalities in Nutritional Status of Children and Women in Nigeria

Turning to the results of the inequality measures and decompositions in nutritional status of children and women in Nigeria, this section first presents results of the inequality measures and decompositions of the three anthropometric indices of the nutritional status of children. Second, the results of inequality measures and decompositions of the three anthropometric indices of the nutritional status of only

malnourished children are presented. Third, the results of the inequality measures and decompositions of the BMIs of women are presented.

5.3.1. Measuring and Decomposing Inequalities in Nutritional Status of Children in Nigeria

Tables 1 to 7 present the results of the Theil L measures and decompositions of inequalities in nutritional status of all children in my sample. In Table 1, the levels and decompositions of urban–rural inequalities in nutritional status of children are shown. Rural inequality in child nutrition tends to be greater than urban inequality. The overwhelming shares of urban–rural inequality among children in Nigeria using the three anthropometric indicators of nutritional status are represented by within-group differences. Although these findings for the three anthropometric indicators of child nutrition for the urban–rural inequality decomposition are interesting, the trend is also similar for all the results derived for inequality decompositions by different demographic and socioeconomic groups (Tables 1–7). The greatest between-groups shares are in the case of the W/A anthropometric indicator of child nutrition by ethnicity (Table 7). Here, the between share of the Theil L inequality decompositions is 4.73. These results are consistent with the results of health inequality decompositions (using the H/A anthropometric indicator as an indicator of health) by Sahn and Stifel (2002) for 26 African countries and with Pradhan, Sahn, and Younger (2003) for selected countries from all the continents of world, where in most cases less than 5 percent of their total inequality is represented by the between-groups share.

Table 1. Inequalities in nutritional status of children by urban–rural residence, Nigeria

	Theil L		
	Height-for-Age	Weight-for-Age	Weight-for-Height
National	0.1604	0.0804	0.1672
Urban inequality	0.1504	0.0673	0.1469
Rural inequality	0.1644	0.0853	0.1782
Within inequality	0.1602	0.0800	0.1669
Between inequality	0.0002	0.0004	0.0003
Within share (%)	99.88	99.50	99.87
Between share (%)	0.12	0.50	0.18

Source: Author’s calculations from the Nigerian Demographic and Health Survey.

In Table 2, there is considerable variation in the degree of intraregional inequality. The Northeast and Northwest have the highest levels of intraregional inequality in child nutrition, whereas intraregional inequality is lowest in the Southeast. Most of all the regional disparities in nutritional status of children are represented by within-region differences, whereas between-regions shares are well below 4 percent.

Table 2. Inequalities in nutritional status of children, by region, Nigeria

	Theil L		
	Height-for-Age	Weight-for-Age	Weight-for-Height
National	0.1604	0.0804	0.1672
Northeast	0.2173	0.1282	0.2160
Northwest	0.2516	0.1212	0.2860
Southeast	0.1018	0.0549	0.1135
Southwest	0.1423	0.0591	0.1436
Central	0.1423	0.0592	0.1407
Within inequality	0.1563	0.0773	0.1658
Between inequality	0.0041	0.0031	0.0014
Within share (%)	97.44	96.14	99.16
Between share (%)	2.56	3.86	0.84

Source: Author’s calculations from the Nigerian Demographic and Health Survey.

In Table 3, we further disaggregate inequalities in nutritional status of children into regional urban–rural inequalities by creating 10 regional divisions for Nigeria from the 5 divisions used in Table 2. Using the three anthropometric indicators of nutritional status, rural inequalities tend to be higher than urban inequalities in the Northeast, Northwest, and Southwest regions of Nigeria. Conversely, rural inequalities are lower than urban inequalities in the Southeast and Central regions of Nigeria. The latter finding is interesting as it debunks the usual assumption that inequalities in nutritional status of children are generally more prevalent in all rural areas than in urban areas in Nigeria. This might not be unconnected with the fact that virtually all the individuals and households living in rural areas of the Southeast and Central regions of Nigeria engage in similar food security ventures (farming), have access to similar health services, and access other underlying and basic determinants of nutritional status. Table 3 also shows that rural areas of the Northeast and Northwest regions have the highest levels of inequalities in nutritional status of children, whereas the rural areas of the Southeast region have the lowest levels of inequalities in nutritional status of children in Nigeria. Again, despite the argument that the between-groups inequality share is driven by the number of groups in inequality decompositions (meaning, the more groups, the higher is the between-groups inequality), the results in Table 3 show that with 10 groups, the shares of between-groups nutritional inequality by regional urban–rural inequality decomposition are small. None of the between-groups inequality shares for all three anthropometric indicators of child nutrition is up to 3.5 percent.

Table 3. Inequalities in nutritional status of children by regional urban–rural residence

	Theil L		
	Height-for-Age	Weight-for-Age	Weight-for-Height
National	0.1604	0.0804	0.1672
Northeast urban	0.1741	0.0709	0.0883
Northwest urban	0.1480	0.0768	0.2989
Southeast urban	0.1905	0.0829	0.1349
Southwest urban	0.1211	0.0519	0.1267
Central urban	0.1403	0.0824	0.2068
Northeast rural	0.2301	0.1447	0.2604
Northwest rural	0.2675	0.1326	0.2811
Southeast rural	0.0776	0.0502	0.1084
Southwest rural	0.1767	0.0667	0.1605
Central rural	0.1371	0.0511	0.1141
Within inequality	0.1550	0.0776	0.1654
Between inequality	0.0054	0.0028	0.0018
Within share (%)	96.63	96.52	98.92
Between share (%)	3.37	3.48	1.08

Source: Author’s calculations from the Nigerian Demographic and Health Survey.

In Table 4, the levels of nutritional inequalities are higher among male children than among female children when using the H/A Z-score. However, for the W/A and W/H Z-scores, the levels of inequalities are higher among female children than among male children. Yet according to their sex, within-group inequality accounts for most of the disparities in nutritional status found among these children.

Table 4. Inequalities in nutritional status of children, by sex, Nigeria

	Theil L		
	Height-for-Age	Weight-for-Age	Weight-for-Height
National	0.1604	0.0804	0.1672
Female	0.1407	0.0812	0.1702
Male	0.1777	0.0786	0.1617
Within inequality	0.1595	0.0799	0.1658
Between inequality	0.0009	0.0005	0.0014
Within share (%)	99.44	99.38	99.16
Between share (%)	0.56	0.62	0.84

Source: Author's calculations from the Nigerian Demographic and Health Survey.

In Table 5, the levels of inequalities are higher among children living in male-headed households than among those in female-headed households using the three anthropometric indicators of nutritional status. Within-group inequality accounts for most of the disparities in nutritional status found among children by sex of the household head, whereas the shares of between-groups inequality tend to be negative even using the Theil L for H/A (-0.12 percent)

Table 5. Inequalities in nutritional status of children, by sex of household head, Nigeria

	Theil L		
	Height-for-Age	Weight-for-Age	Weight-for-Height
National	0.1604	0.0804	0.1672
Male	0.1689	0.0823	0.1711
Female	0.0844	0.0524	0.1175
Within inequality	0.1606	0.0794	0.1660
Between inequality	-0.0002	0.0010	0.0012
Within share (%)	100.12	98.76	99.28
Between share (%)	-0.12	1.24	0.72

Source: Author's calculations from the Nigerian Demographic and Health Survey.

In Table 6, the levels of inequalities are highest among children whose mothers have had no education, using all three anthropometric indicators of nutrition. Levels of nutritional inequalities among children whose mothers have had primary education tend to follow those whose mothers have had no education. The levels of nutritional inequalities among children whose mothers have had higher education are surprisingly higher than those whose mothers have had only secondary education, using the H/A Z-score. As explained above, this could be due to a very small subsample of mothers with higher education in the NDHS. Nevertheless, the levels of nutritional inequalities for both groups of children are not remarkably different, using the W/A and W/H Z-scores. Again, the within-group inequality constitutes most of the shares of inequality decomposition in nutritional status of children, by educational attainments of mothers.

Table 6. Inequalities in nutritional status of children, by education of mothers, Nigeria

	Theil L		
	Height-for-Age	Weight-for-Age	Weight-for-Height
National	0.1604	0.0804	0.1672
No education	0.2184	0.1096	0.2074
Primary	0.1286	0.0604	0.1558
Secondary	0.1159	0.0604	0.1303
Higher	0.1288	0.0585	0.1157
Within inequality	0.1584	0.0787	0.1662
Between inequality	0.0020	0.0017	0.0010
Within share (%)	98.75	97.89	99.40
Between share (%)	1.25	2.11	0.60

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Table 7 shows that nutritional inequality is lowest among children living in large capital cities, in terms of the three indicators of nutrition. Inequality in H/A tends to be highest in small cities, whereas inequality in W/A seems to be highest in towns. The countryside seems to account for the highest inequality in W/A. The within-group inequality share accounts for almost all the disparities in the nutritional status of children.

Table 7. Inequalities in nutritional status of children, by location, Nigeria

	Theil L		
	Height-for-Age	Weight-for-Age	Weight-for-Height
National	0.1604	0.0804	0.1672
Capital, large city	0.0725	0.0372	0.0842
Small city	0.1728	0.0672	0.1488
Town	0.1687	0.0887	0.1494
Countryside	0.1637	0.0853	0.1782
Within inequality	0.1594	0.0797	0.1653
Between inequality	0.0010	0.0007	0.0019
Within share (%)	99.38	99.13	98.86
Between share (%)	0.62	0.87	1.14

Source: Author's calculations from the Nigerian Demographic and Health Survey.

In Table 8, the Hausa ethnic group has the highest levels of inequalities in terms of all the three anthropometric indicators of nutritional status. This is not surprising as the majority of Hausa people in Nigeria live in the Northeast and Northwest regions of the country, where inequalities in nutritional status of children are the highest among all the regions of Nigeria. What is surprising, however, is that for the H/A and W/A anthropometric indicators of nutrition, the Igbo ethnic group has higher levels of inequalities than the Yoruba ethnic group. This is surprising because the Southeast, which records the lowest levels of malnutrition prevalence of children, is the regional zone of the Igbos. Nevertheless, the Igbos are scattered all over Nigeria, engaging in various activities, and hence the measurement and weighing of Igbo children could have taken place in any of the other regions of Nigeria rather than just the Southeast. Again, the within-group inequality constitutes most of the shares of inequality decomposition in child nutrition by ethnicity.

Table 8. Inequalities in nutritional status of children, by ethnicity, Nigeria

	Theil L		
	Height-for-Age	Weight-for-Age	Weight-for-Height
National	0.1604	0.0804	0.1672
Hausa	0.2641	0.1238	0.2291
Igbo	0.1255	0.0620	0.0997
Yoruba	0.1232	0.0504	0.1349
Others	0.1488	0.0774	0.1706
Within inequality	0.1592	0.0766	0.1648
Between inequality	0.0012	0.0038	0.0024
Within share (%)	99.25	95.27	98.56
Between share (%)	0.75	4.73	1.44

Source: Author's calculations from the Nigerian Demographic and Health Survey.

5.3.2. Measuring and Decomposing Inequalities in Child Malnutrition in Nigeria

This subsection presents the results of inequality measures and decompositions using the three anthropometric indices of nutritional status of children with Z-scores below -2 standard deviations from the median of the NCHS reference population in terms of H/A, W/A, and W/H.¹¹ These are referred to as stunting, underweight, and wasting inequalities, respectively. Measurement and decomposition of inequalities in child malnutrition are undertaken by drawing comparisons within and between different demographic and socioeconomic groups.

Appendix Table 5 presents the results of the calculations of the Theil L measures and decompositions of inequalities in child malnutrition in Nigeria by demographic and socioeconomic groups. As with the inequalities in the nutritional status of all children, the overwhelming shares of urban–rural inequalities in child malnutrition in Nigeria are represented by within-group differences. Although these findings for the stunting, wasting, and underweight inequalities decomposition are interesting, there is also evidence that within-group inequalities are the sources of most inequalities in child malnutrition, rather than the differences between demographic and socioeconomic groups.

On region of children, it is evident that although the Northwest region tends to have the highest level of inequality in stunting, the Northeast region has the highest levels of inequalities in underweight and wasting. The lowest level of inequality in stunting is recorded in the Southeast region, whereas the Southwest has the lowest levels of inequalities in underweight and wasting. Although within-group inequalities account for most of the disparities in malnutrition among children by region, there is an appreciable increase in the share of between-groups inequalities. For instance, the share of differences in underweight between the five regions in Nigeria is 9.6 percent (Appendix Table 5). On child's sex, the level of inequality in stunting among male children tends to be higher than that of female children. The levels of inequalities in underweight and wasting among female children seem to be higher than those present among male children. Within-group inequalities are the sources of most of the disparities in malnutrition among children by child's sex.

On education of mothers, the levels of inequalities in stunting and underweight are highest among children whose mothers have had no education, whereas those whose mothers have primary education have the highest level of inequality in wasting. Although inequality in stunting is lowest among children whose mothers have secondary education, the levels of inequalities in underweight and wasting are lowest among children whose mothers have had higher education. These results show that within-group inequalities account for most inequalities in child malnutrition by education of mothers. On sex of the household head, the levels of inequalities in stunting and underweight are higher in male-headed households. Both male-headed and female-headed households have the identical level of inequality in

¹¹ This is the type of inequality decomposition carried out by Wagstaff and Watanabe (2000); Sahn and Stifel (2002); and Pradhan, Sahn, and Younger (2003) among others.

wasting (0.0216). Although the share of between-groups inequality in stunting by sex of household head is 5.15 percent, the corresponding figures are -2.92 and 1.88 percent for underweight and wasting, respectively.

On location of children, inequalities in stunting, underweight, and wasting are lowest among children whose locations are large capital cities. Inequality in stunting tends to be highest in small cities, whereas inequalities in underweight and wasting seem to be highest in the countryside. Within-group inequality share accounts for most of the disparities in child malnutrition by location of children, with the share of between-groups inequality in underweight being as low as 0.58 percent. On the ethnic groups in Nigeria, the Hausa ethnicity clearly has the highest levels of inequalities of stunting, underweight, and wasting. Although the Igbo ethnicity has the lowest levels of inequalities in stunting and wasting, the Yoruba ethnicity has the lowest level of inequality in underweight. Although within-group inequalities still account for most of the disparities in stunting, underweight, and wasting by ethnicity, these results show considerable shares in between-groups inequalities.

On the source of drinking water, inequality in stunting is more profound among children whose source of water is wells in residence, whereas those who drink water from public wells are more unequal in term of underweight. The level of inequality in wasting is highest among children who drink water from other sources. These other sources of water include dams, ponds, lakes, rainwater, surface water, springs, and so forth. There are also appreciable shares of between-groups inequalities by source of drinking water. On child's age, the level of inequality in stunting is highest among children aged 27 to 35 months, whereas the level of inequality in underweight tends to be highest among children aged 9 to 17 months. The level of inequality in wasting is highest among children aged 18 to 26 months. Again, within-group inequalities are the sources of most disparities in stunting, wasting, and underweight, by child's age.

5.3.3. Measuring and Decomposing Inequalities in Nutritional Status of Women in Nigeria

This subsection presents the results of inequality measures and decompositions using the BMIs of nutritional status across women. Comparisons are drawn within and between different demographic and socioeconomic groups. Appendix Table 6 shows the results of the Theil L measures and decompositions of inequality in nutritional status of women in Nigeria by different demographic and socioeconomic groups. The trend of the results of measures and decompositions of inequality in nutritional status of women is similar to the trend observed in inequality measures and decompositions of nutritional status in children (see subsection 5.3.1.). For instance, rural inequality in nutritional status of women tends to be greater than urban inequality. Northeast and Northwest regions have the highest levels of inequalities in nutritional status of Nigerian women compared to other regions of Nigeria, and so forth. The implication of these findings is that the determinants of inequalities in nutritional status of women in Nigeria have important impacts on inequalities in nutritional status of their children. Thus, for instance, a more egalitarian society in terms of outcomes of nutritional status increases the chance of relatively equal determinants of nutritional status for both Nigerian women and their children.

The most important finding in Appendix Table 6 is that as with the decomposition of inequalities in nutritional status of children, within-group inequality constitutes most of the disparities in inequality decompositions of nutritional status of women by different demographic and socioeconomic groups. In fact, with the use of the Theil L index, the greatest between-groups share (3.98 percent) is observed when analysis of inequality decomposition of women's nutritional status was disaggregated into 10 groups of regional urban-rural decomposition. The Theil L even recorded negative values for the between-groups shares of inequality decomposition of women's nutritional status by some background characteristics such as age (-4.78 percent) and marital duration (-1.59 percent). Again, these results are consistent with the results of health inequality decompositions by Sahn and Stifel (2002) for 26 African countries and with the results of Pradhan, Sahn, and Younger (2003) for selected countries from all the continents of world. The question one might reasonably ask is, Does the decomposition of inequality in nutritional status give

similar between-groups shares and within-group shares to the income inequality decomposition? The next subsection briefly answers this question.

5.3.4. Difference between Decomposition of Inequality in Nutritional Status and Income Inequality Decomposition

As evidenced in this paper, inequalities within demographic and socioeconomic groups in Nigeria are the sources of most of the disparities observed in nutritional status of children and women. Inequalities between demographic and socioeconomic groups are less important. The results of inequality decompositions using nutritional status contrasts with the more usual decompositions of income inequality. Although none of the shares of between-groups inequalities observed in nutritional inequality decompositions carried out among children and women in Nigeria is up to 10 percent, evidence from decompositions of income/expenditure inequality show that the share of between-groups inequalities is usually 10 to 15 percent of total inequality (Kanbur 2002a).

Moreover, it has been found that the share of between-groups inequalities of income/expenditure inequality decompositions can sometimes be very high. For instance, Milanovic (1999) carried out Theil decomposition on world income inequality in 1993 and 1999 and finds out that three-quarters of world income inequality is dominated by between-groups differences whereas only one-quarter of world income inequality accounts for the within-group disparities. Firebaugh (cited in Pradhan, Sahn, and Younger 2001) also reviews numerous studies that decompose income inequality into between-groups and within-group components, and his review shows that between-groups inequality contributes between 65 and 79 percent of total income inequality.¹² In contrast, Pradhan, Sahn, and Younger (2003) and Sahn and Stifel (2002) carry out Theil decomposition on health inequality,¹³ and their results, which are similar to the results derived in this paper, show that in most cases less than 5 percent of their total inequality is represented by the between-groups inequality. Pradhan, Sahn, and Younger have argued that the results of income inequality decomposition differ from health inequality decomposition because the relationship between income/expenditure and health, particularly when measured by nutrition indicators such as stunting, is a strongly concave function. This difference between income/expenditure inequality and inequality in nutritional status is relevant for policy. It implies that for the purpose of addressing inequalities in nutritional status of children and women in Nigeria, and indeed in many countries, policies that focus attention on addressing within-group inequalities should be introduced and implemented.

5.4. Relationship between Inequalities in Child Malnutrition and the Prevalence of Child Malnutrition in Nigeria

This subsection explores whether there is any relationship between levels of inequalities in stunting, underweight and wasting and the prevalence of stunting, underweight and wasting in Nigeria. Given the focus in international and national development targets on average rates of malnutrition, it is of some interest to establish how average rates of malnutrition and inequalities in malnutrition compare by different demographic and socioeconomic groups within a country. Ideally, it would be good for policymakers and target setters to concern themselves with both dimensions.

In Appendix Tables 7, 8 and 9 the rankings of levels of inequalities in stunting, underweight and wasting versus rankings of prevalence of stunting, underweight and wasting are presented from smallest to highest values by background characteristics. The argument here is that if the inequality in child malnutrition and the prevalence of child malnutrition were similar, one would reasonably expect the rankings of both dimensions of malnutrition to be the same. But this is not the case for many of the background characteristics listed in Appendix Tables 7, 8 and 9.

¹² Theil decomposition was carried out in most of the studies reviewed. However, some of the studies rely on log variance decompositions.

¹³ They use height-for-age (stunting) as a proxy for health.

To present clearer pictures of the relationship between inequality in child malnutrition and the prevalence of child malnutrition (meaning, the average rates), Appendix Figures 1 to 3 show scatter plots with the latter on the x-axis and the former (meaning, the Theil L inequality) on the y-axis. The labels in these figures are numbers, which represent different background characteristics as shown in the first column of Appendix Tables 7 and 8. There is a small group of children who have the same background characteristics; who have low levels of stunting, underweight, and wasting; and who also have relatively low levels of inequality and vice versa. However, beyond that group, and for the great majority of children, there is no strong discernable relationship between the prevalence of child malnutrition and inequality in child malnutrition. For example, in the case of stunting, children in urban Nigeria, children from the Hausa ethnic group, and children from the Southwest region all have nearly identical inequality parameters (0.0442, 0.0448, and 0.0438, respectively). However, the levels of stunting in these groups are 41.7, 60.2, and 38.8 percent, respectively (Appendix Figure 1).

As far as underweight is concerned, children living in the countryside have the same inequality in the underweight parameter with those from the Hausa ethnic group (0.0371), but their levels of underweight are 27.7 and 45.8 percent, respectively. In fact, children can be roughly classified into four groups based on their average underweight rates and their inequalities in underweight. The first group can be characterized as having win-win situation with a relatively low prevalence of underweight along with a low inequality in underweight (for example, children living in the Southeast region and large capital cities). The second group combines a relatively low underweight rate with a relatively high inequality in underweight (for example, children from other ethnic groups). The third group combines relatively high underweight rates with a low inequality in underweight (such as children living in Nigerian towns). The last group can be characterized as having lose-lose situation with a relatively high prevalence of underweight along with a high inequality in underweight (such as children living in the Northeast and Northwest regions) (Appendix Figure 2).

In the case of wasting, children living in the Northwest region of Nigeria tend to have lower inequality in the wasting parameter (0.0205) than those in central Nigeria (0.0211). Yet the level of wasting in the Northwest region is twice that in central Nigeria. The story of the relationship between the prevalence of wasting and inequality in wasting is not different from the case of underweight above, with three clear identifiable groups: the win-win group (for example, children living in capital cities), the lose-lose group (such as children living in the Northeast region), and the group with a relatively high inequality in wasting and low prevalence of wasting (such as children drinking water from other sources) (Appendix Figure 3).

The paper complements the analysis above with a Pearson correlation¹⁴ analysis of the relationship between inequality in child malnutrition and the prevalence of child malnutrition in Nigeria (Appendix Tables 7, 8 and 9). It would make sense to focus on inequalities in child malnutrition alone if there were a strong and significant association between the latter and the prevalence of child malnutrition. Although the correlation between inequality in stunting and the prevalence of stunting is not so strong (.53), it is significant (Appendix Table 7). The correlation between inequality in underweight and the prevalence of underweight is weak (.43) but significant (Appendix Table 8). The correlation between inequality in wasting and the prevalence of wasting is weak (.32) and insignificant (Appendix Table 9). This finding implies that rather than focusing only on average levels of child malnutrition (prevalence) in Nigeria, as it is the usual practice, it is better to focus on both average levels of malnutrition and inequalities in child malnutrition.

One thing that is clear from above is that although some children do better in terms of both the average (prevalence of child malnutrition) and the distribution (inequality in child malnutrition), children with comparable levels of overall nutritional status do not necessarily have the same levels of nutritional

¹⁴ The Pearson correlation coefficient is the most common measure of correlation, and it is fully called the Pearson product-moment correlation. It shows the strength of the linear relationship between variables and reflects the degree to which they are related. It ranges from +1 to -1. A correlation of +1 means that there is a perfect positive linear relationship between variables.

inequality and vice versa (see also Pradhan, Sahn, and Younger 2003; Wagstaff and Watanabe 2000). The scatter plots (Appendix Figures 1 to 3) tend to show the risk of setting targets and comparing characteristics solely in terms of malnutrition rates. Children from the Yoruba ethnic group, for example, have a higher underweight rate than those from other, smaller ethnic groups (about 28 percent among Yoruba children compared to 24 percent among children of other, smaller ethnic groups). Without knowledge of inequality in underweight, one would conclude that the problem of underweight is worse among Yoruba children than among children of other, smaller ethnic groups in Nigeria. But understanding that inequality in underweight among Yoruba children is much lower than underweight inequality among children of other, smaller ethnic groups makes it much harder to arrive at this conclusion.

5.5. Relationship between Indicators of Child Malnutrition in Nigeria

This subsection explores the correlations between the three most commonly used indicators of child malnutrition (stunting, underweight, and wasting) in Nigeria. How related are the three dimensions of child malnutrition among Nigerian children? Will nutritional policy that focuses on one of the three dimensions of child malnutrition also target other dimensions of child malnutrition in Nigeria? Should Nigerian nutritional policy select only stunted children, only underweight children, or only wasted children? Answers to these questions are important when designing a nutrition improvement policy for Nigerian children. For instance, it would make sense for Nigerian nutritional policy to focus only on stunted children if there were a strong and significant association between stunting, underweight, and wasting in Nigeria.

Appendix Table 10 shows the Pearson correlation matrixes for the prevalence of stunting, underweight, and wasting in Nigeria. There are strong (high) and significant correlations between the prevalence of stunting and underweight (.71) and between the prevalence of underweight and wasting (.83). The association between the prevalence of stunting and wasting is rather weak (.42) even though it is significant. This finding implies that most Nigerian children who are both stunted and underweight are not likely to be wasted; that is, most Nigerian children can be stunted and underweight or be underweight and wasted, but they are not very likely to be stunted and wasted.¹⁵ It then makes sense that rather than addressing all three indicators of child malnutrition, it is better for Nigerian nutritional policy, given resource constraints, to focus on the monitoring or eradication of stunting and wasting.

5.6. Relationship between Inequalities in Indicators of Child Malnutrition in Nigeria

This subsection explores the correlations between inequalities in stunting, underweight, and wasting among under-three children in Nigeria. Are the children with a relatively high degree of inequality on one indicator of child malnutrition the same children with relatively high degrees of inequality on other indicators of child malnutrition in Nigeria? The answer to this question is important because many analysts focus only on inequality in stunting and not inequalities in underweight and wasting.¹⁶ It would make sense to focus only on inequality in stunting if there were a strong and significant association between inequality in stunting and inequalities in underweight and wasting.

Appendix Table 11 shows the Pearson correlation matrixes for the inequalities (Theil L) in stunting, underweight, and wasting in Nigeria by different demographic and socioeconomic characteristics. There

¹⁵ Please note that the results presented here articulate the interrelationship among the three dimensions of child malnutrition and are consistent with the nutritional literature in that children who are both stunted and underweight will be most unlikely to be wasted (meaning to have a very low weight-for-height Z-score) (see, for instance, Wagstaff and Watanabe 2000). The result is not too surprising since weight-for-age (underweight) is influenced by the height and weight of a child and is thus a composite index of height-for-age (stunting) and weight-for-height (wasting). This makes its interpretation difficult since it does not differentiate between acute malnutrition (wasting) and chronic malnutrition (stunting).

¹⁶ For instance, Pradhan, Sahn, and Younger (2001) use stunting inequality as a proxy for health inequality in their decomposition of world health inequality. Sahn and Stifel (2002) also focus on stunting inequality as a proxy for health inequality in their decomposition of urban–rural health inequality in Africa.

are weak (low) and insignificant correlations between the Theil L inequalities in stunting and wasting (.12) and between the Theil L inequalities in underweight and wasting (.29). The strongest association is observed for the Theil L inequalities in stunting and underweight (.34). Although the latter association is significant, it is still weak. This finding implies that the fact that some children are relatively more unequal in term of one indicator of child malnutrition does not mean that the same children are consistently unequal in terms of other indicators of child malnutrition and vice versa. It then makes sense that rather than addressing only inequality in stunting in Nigeria, it is better to focus on inequalities in each indicator of child malnutrition. However, given resource constraints, inequalities in stunting and wasting seem the most appropriate to address.

6. SUMMARY AND CONCLUSIONS

This paper has explored the patterns and trends of inequalities in child and maternal nutritional status in Nigeria using data from the NDHS. The paper has also explored the prevalence of child and maternal malnutrition in Nigeria to identify the most vulnerable groups in Nigeria. This paper has shown that the most vulnerable groups among children and women in Nigeria in terms of malnutrition are those from the least educated households, the rural population, those from the Northern regions of Nigeria (in particular its Hausa ethnic group), and those who drink water from public wells. Moreover, children living in male-headed households are more vulnerable to malnutrition than those living in female-headed households. Male children are more likely to be malnourished than female children, contrary to the prevailing belief that female children require much more nutritional intervention than male children in Nigeria. Nigerian children are more likely to be malnourished during the first months of their life.

An important finding in this paper is that malnutrition in Nigeria is a vicious cycle in that child malnutrition can be traced back partly to low birth weight (and therefore to maternal malnutrition). The incidence of low birth weight not only is an important indicator of prospects for child survival but also indirectly indicates the nutritional status of mothers. A malnourished Nigerian girl is thus more likely to become a malnourished adolescent and later a malnourished woman. To interrupt this vicious cycle, the Nigerian government needs to take targeted and concerted action in the areas of primary healthcare, access to basic services (such as safe drinking water and good sanitation), adequate care, and direct nutritional interventions for malnourished children. These actions, which are associated with the determinants of nutritional status, should be tailored to support crucial direct nutrition interventions such as community-based programs that can improve home-based caring practices, micronutrient supplementation, correct feeding practices, and food fortification (Gillespie et al. 1996).¹⁷ Furthermore, Nigerian nutrition policy (which gives greater attention to female children) should be repackaged to give equal attention to both male children and female children, as analysis has shown that male children in Nigeria are more likely to be stunted and underweight than female children.

Since the results presented in the paper show that malnutrition is higher among Nigerian children during the first months of life (up to the first 26 months), Nigerian nutritional policy needs to directly target preschool children, in contrast to most of the existing programs that target only children in school. This is particularly important as the brains of children grow most rapidly in early childhood and preschool children are more vulnerable since their immune systems are not yet fully developed. If Nigerian nutrition policy is to urgently select a target group of malnourished children and women, given resource constraints and knowledge of the costs of alternative interventions, children and women in rural Nigeria and northern Nigeria should be targeted since they suffer greatly from malnutrition and their current levels of achievement in reaching the desired levels of the determinants of nutritional status are rather poor.

Investing in the education of women in Nigeria would give them a greater sense of self-esteem and self-confidence, as well as a greater level of resources, enabling them to assert their rights and play a greater role in decisionmaking within the family, particularly decisionmaking concerning their care and well-being as well as those of their children. An integral part of the strategies for reducing child and maternal malnutrition in Nigeria should therefore include improvement of women's education, bolstering of women's status, and creation of healthy environments. In addition, the Nigerian nutrition policy, which emphasizes the socioeconomic and spatial rights to nutrition for all children and women in the country, should concern itself with children living in male-headed households, not only those in female-headed households as the practice has always been. Nutritional education programs are needed at the household level. By emphasizing the importance of a more balanced diet, they could address malnutrition in both children and women.

¹⁷Analysis of different programs in other parts of the world by Gillespie et al. (1996) has shown that community-based programs are the most cost-effective interventions for child malnutrition.

Turning to the measurement of inequalities in nutritional status of children and women in Nigeria, there are large inequalities in the nutritional status of children and women. As with the average rates of malnutrition, inequalities in nutritional status of children and women in rural Nigeria and northern Nigeria are higher than those observed in urban Nigeria and southern Nigeria, respectively. However, on disaggregating further, rural inequalities in the nutritional status of children are found to be lower than urban inequalities in the Southeast and Central regions of Nigeria. The latter debunks the usual assumption that inequalities in nutritional status are generally more prevalent in all rural areas than urban areas in Nigeria. Furthermore, the levels of inequalities in nutritional status are higher among children living in male-headed households than those in female-headed households. The levels of inequalities in nutritional status are higher among children whose mothers have had no education than among those whose mothers have had some education. Among the three major ethnic groups in Nigeria, the Hausa ethnic group has the highest levels of inequalities in nutritional status of children and women.

The disparities in nutritional status of children and women underscore the need to pay attention to differences in demographic and socioeconomic groupings when designing policy interventions to reduce or eliminate malnutrition in Nigeria. Policies should also be conscious of equitable distribution of basic social services (for example, water, sanitation, nutrition, adequate health, education, food security). Political economy issues of the role of power and social groupings (for example, rural versus urban groups) in the provision and financing of these services are important. Technical and economic demonstration of the superior role of these services in enhancing health and nutritional status of children and women will not in itself be sufficient to ensure their provision or guarantee that they would be provided equitably to all socioeconomic groups. The political processes of resource allocation and of policy implementation need to be understood and manipulated so as to have the above services provided at adequate levels. In any case, the issue of food security is a matter that can best be handled through political actions such as the establishment of social security systems and a free press that can report situations of malnutrition. Sen (1981), in his seminal work on famines, has demonstrated that hunger and malnutrition are not primarily due to food shortages. Rather, these health-reducing phenomena occur mainly because of poor food distribution and the lack of people's entitlement to food, which is available through the market system. Sen has also argued that a free press is important in alerting the government and international agencies (of good will) of potential situations of severe hunger and malnutrition.

Probably the most important finding of this paper is that inequalities within demographic and socioeconomic groups in Nigeria are the sources of most of the disparities observed in the nutritional status of children and women. Inequalities between demographic and socioeconomic groups are less important. It implies that for the purpose of addressing inequalities in nutritional status of children and women in Nigeria, and indeed in many countries, policies that focus attention on addressing within-group inequalities should be introduced and implemented. Such a focus might be the focus of national nutrition policy through community-based programs (for example, generation and building of institutional capabilities for effective community ownership of nutrition security interventions) and household-level programs (for example, improvement of the living conditions of families).

With the aid of correlation matrixes and scatter plots, this paper has shown that it would be good for nutritional policymakers and target setters in Nigeria to concern themselves with both average rates of malnutrition and inequalities in malnutrition. This is because the correlations between average rates of malnutrition and inequalities in malnutrition, as measured by stunting, underweight, and wasting, are not so strong. However, there are some groups of children in Nigeria that can be categorized as having a lose-lose situation, with a relatively high prevalence of malnutrition along with high inequalities in malnutrition (such as children from the Northeast and Northwest regions). Some children can be categorized as having a win-win situation, with a relatively low prevalence of malnutrition along with low inequalities in malnutrition (for example, children from the Southeast region and those living in capital cities). This implies that Nigerian nutritional policymakers and target setters need to seriously address the malnutrition problem of children in northern Nigeria, who are chiefly from the Hausa ethnic group. Strategies for reducing average levels of malnutrition and inequalities in malnutrition among children in northern Nigeria should address all the underlying and basic determinants of nutritional status. The scale

and consistency of the disparities in the nutritional status of children point strongly to the need to give a clear priority to programming in northern Nigeria. Monitoring systems would also need to be put in place to track the extent of progress at state and local government levels in northern Nigeria.

Examining the relationship between the three most commonly used anthropometric indicators of child malnutrition (stunting, underweight, and wasting) as well as the relationship between the inequalities of these anthropometric indicators of child malnutrition, this paper has shown that most Nigerian children who are both stunted and underweight are not likely to be wasted. This implies that most Nigerian children can be stunted and underweight or be underweight and wasted, but they are not very likely to be stunted and wasted. This finding implies that given resource constraints, it would make sense for Nigerian nutritional policymakers to focus attention on monitoring or combating stunting and wasting. This paper has also shown that there are weak and insignificant correlations between inequalities in stunting and wasting, between inequalities in underweight and wasting, and between inequalities in stunting and underweight in Nigeria. This implies that it is better for Nigerian nutritional policymakers to focus on inequalities in each indicator of child malnutrition. However, given resource constraints, inequalities in stunting and wasting seem the most appropriate to address.

In conclusion, the decomposition procedure used in this paper represents a useful starting point for understanding the determinants of inequalities in nutritional status. However, the decomposition technique leaves much of the inequality unexplained. For example, what accounts for the large within-group inequalities in nutritional status of children and women that are typically observed? The decomposition methods employed in the paper ultimately identify correlations, which suggest but do not imply causality. The inferences of causation that can be drawn from the inequality decompositions are merely suggestive. More understanding of the factors behind patterns and trends of inequalities in nutritional status is required in the policy debate, notably of the processes behind inequalities in nutritional status. These need to be based on broader understandings of inequality and are likely to require both qualitative and quantitative research methods. Qualitative techniques seem to be more crucial in identifying the underlying processes and in understanding relationships between the different dimensions of inequalities in nutritional status. This should undoubtedly be a vital priority in future research on patterns of inequalities in nutritional status. Nevertheless, it is hoped that the findings of this paper can be a first step that assists Nigerian nutritional policymakers to understand the proximate causes of patterns and trends of inequalities in the nutritional status of children and women.

APPENDIX: SUPPLEMENTARY TABLES AND FIGURES

Table A.1. Descriptive statistics of height-for-age Z-scores of selected children, by background characteristics, Nigeria

Background Characteristic	Number of Children	Mean	Standard Deviation	Minimum	Maximum	
Residence	Urban	N=431	-1.49	2.09	-5.77	5.27
	Rural	N=1025	-1.69	2.10	-5.99	5.64
Region	Northeast	N=302	-2.10	2.12	-5.99	3.67
	Northwest	N=116	-2.02	2.37	-5.95	5.48
	Southeast	N=366	-1.28	1.93	-5.77	5.27
	Southwest	N=389	-1.23	2.14	-5.91	5.60
	Central	N=283	-1.97	1.94	-5.84	5.64
Location	Capital, large city	N=96	-1.15	1.69	-5.34	3.28
	Small city	N=213	-1.68	2.12	-5.77	4.82
	Town	N=122	-1.44	2.28	-5.76	5.27
Education of mother	Countryside	N=1025	-1.69	2.10	-5.99	5.64
	No education	N=545	-2.02	2.25	-5.99	5.60
	Primary	N=406	-1.45	1.96	-5.84	5.27
	Secondary	N=440	-1.34	1.97	-5.76	5.64
Age group of mother	Higher	N=65	-1.40	1.93	-5.77	3.53
	15-19	N=109	-1.60	2.12	-5.78	4.14
	20-24	N=310	-1.70	2.02	-5.99	5.64
	25-29	N=442	-1.68	2.04	-5.94	4.96
	30-34	N=322	-1.57	2.15	-5.95	5.60
	35-39	N=188	-1.42	2.24	-5.37	5.27
	40-44	N=56	-1.63	2.38	-5.79	3.58
	45-49	N=29	-2.29	1.59	-5.02	.84
Ethnicity	Hausa	N=249	-2.28	2.18	-5.99	3.66
	Igbo	N=229	-1.01	2.23	-5.77	5.60
	Yoruba	N=339	-1.55	1.85	-5.79	5.17
	Other ethnicities	N=599	-1.67	2.09	-5.91	5.64
Sex of child	Male	N=739	-1.76	2.10	-5.95	5.64
	Female	N=717	-1.50	2.09	-5.99	5.48
Marital duration of mothers	Never married	N=29	-1.39	2.22	-5.42	4.14
	0-4	N=362	-1.48	1.93	-5.78	5.64
	5-9	N=433	-1.62	2.07	-5.99	5.48
	10-14	N=281	-1.61	2.20	-5.95	5.53
	15-19	N=198	-1.74	2.30	-5.95	5.60
	20-24	N=109	-1.71	2.20	-5.79	3.58
	25-29	N=39	-2.55	1.47	-5.64	.75
	Sex of household head	Male	N=1314	-1.65	2.13	-5.99
	Female	N=142	-1.43	1.79	-5.02	4.14
Child's Age	0-8 months	N=341	-.79	1.87	-5.76	5.60
	9-17 months	N=371	-1.62	2.07	-5.95	5.64
	18-26 months	N=371	-2.04	2.11	-5.95	5.27
	27-35 months	N=373	-2.00	2.09	-5.99	4.79
Source of drinking water	Piped into residence	N=133	-1.59	2.04	-5.64	4.19
	Public tap	N=218	-1.61	2.02	-5.77	4.14
	Well in residence	N=202	-1.79	2.35	-5.99	5.48
	Public well	N=241	-1.84	2.02	-5.94	3.67
	River, stream	N=345	-1.62	2.09	-5.91	5.64
	Borehole	N=184	-1.45	1.92	-5.61	3.13
	Other sources	N=109	-1.25	2.19	-5.46	5.60
All Children		N=1456	-1.63	2.10	-5.99	5.64

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Table A.2. Descriptive statistics of weight-for-Age Z-scores of selected children, by background characteristics, Nigeria

Background Characteristic	Number of Children	Mean	Standard Deviation	Minimum	Maximum	
Residence	Urban	431	-.83	1.85	-5.47	5.94
	Rural	1,025	-.89	1.93	-5.75	5.67
Region	Northeast	302	-1.33	2.06	-5.75	5.67
	Northwest	116	-1.48	2.11	-5.53	5.37
	Southeast	366	-.41	1.81	-5.47	5.94
	Southwest	389	-.76	1.86	-4.97	5.62
	Central	283	-.89	1.66	-5.29	4.02
Location	Capital, large city	96	-.74	1.42	-3.96	3.81
	Small city	213	-.68	1.85	-5.47	5.04
	Town	122	-1.16	2.10	-5.29	5.94
	Countryside	1,025	-.89	1.93	-5.75	5.67
Education of mother	No education	545	-1.22	2.05	-5.75	5.67
	Primary	406	-.78	1.80	-5.65	5.94
	Secondary	440	-.57	1.78	-5.47	5.17
	Higher	65	-.64	1.82	-3.96	4.83
Age group of mother	15-19	109	-1.11	1.89	-5.17	3.55
	20-24	310	-.96	1.84	-5.72	5.67
	25-29	442	-.86	1.99	-5.65	5.64
	30-34	322	-.83	1.73	-5.22	4.58
	35-39	188	-.61	2.09	-5.75	5.94
	40-44	56	-.81	2.15	-5.67	5.04
	45-49	29	-1.41	1.49	-3.65	2.37
Ethnicity	Hausa	249	-1.62	1.96	-5.75	5.37
	Igbo	229	-.13	2.05	-5.47	5.94
	Yoruba	339	-1.05	1.58	-4.97	5.26
	Other ethnicity	599	-.76	1.89	-5.72	5.67
Sex of child	Male	739	-.98	1.85	-5.65	5.94
	Female	717	-.76	1.96	-5.75	5.67
Marital duration of mother	Never married	29	-.72	2.00	-5.29	3.55
	0-4	362	-.80	1.75	-5.17	5.62
	5-9	433	-.73	1.96	-5.72	5.67
	10-14	281	-1.01	1.93	-5.65	5.94
	15-19	198	-.93	1.99	-5.36	5.37
	20-24	109	-.96	1.99	-5.75	5.04
	25-29	39	-1.58	1.61	-4.78	2.15
Sex of household head	Male	1,314	-.89	1.94	-5.75	5.94
	Female	142	-.74	1.59	-5.29	4.73
Child's age	0-8 months	341	-.22	1.96	-5.65	5.67
	9-17 months	371	-1.13	1.94	-5.75	5.64
	18-26 months	371	-1.09	1.76	-5.47	5.94
	27-36 months	373	-1.00	1.85	-5.72	5.62
Source of drinking water	Piped into residence	133	-.76	1.97	-5.65	4.83
	Public tap	218	-.77	1.92	-5.75	5.18
	Well in residence	202	-1.05	2.06	-5.11	5.37
	Public well	241	-1.13	1.99	-5.72	5.67
	River, stream	345	-.73	1.83	-5.22	5.94
	Borehole	184	-.93	1.52	-4.82	3.82
	Other sources	109	-.54	2.04	-4.50	5.62
All children		1,456	-.87	1.91	-5.75	5.94

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Table A.3. Descriptive statistics of weight-for-height Z-scores of selected children, by background characteristics, Nigeria

Background Characteristic		Number of Children	Mean	Standard Deviation	Minimum	Maximum
Region	Urban	467	.19	1.86	-4.00	5.32
	Rural	1,116	.30	2.02	-3.99	5.93
	Northeast	365	.10	2.03	-3.99	5.50
	Northwest	159	.05	2.16	-3.98	5.68
	Southeast	372	.50	1.89	-3.97	5.93
	Southwest	392	.06	1.90	-3.91	5.32
	Central	295	.56	1.92	-4.00	5.71
Location	Capital, large city	103	.05	1.65	-2.70	5.03
	Small city	221	.56	1.92	-3.98	5.32
	Town	143	-.29	1.79	-4.00	3.99
	Countryside	1,116	.30	2.02	-3.99	5.93
Education of mother	No education	651	.22	2.07	-3.99	5.71
	Primary	425	.19	1.95	-3.91	5.71
	Secondary	441	.39	1.85	-4.00	5.93
	Higher	66	.36	1.89	-3.08	5.36
Age group of mother	15-19	120	.05	2.20	-3.99	5.60
	20-24	344	.17	1.96	-3.98	5.68
	25-29	467	.27	2.03	-4.00	5.93
	30-34	348	.27	1.80	-3.97	5.71
	35-39	209	.49	2.00	-3.72	5.53
	40-44	63	.45	1.99	-3.93	4.22
	45-49	31	.11	1.85	-3.64	4.94
Ethnicity	Hausa	337	-.05	2.00	-3.98	5.30
	Igbo	232	.65	1.88	-3.48	5.71
	Yoruba	342	-.04	1.79	-3.91	5.06
	Other ethnicity	631	.47	2.03	-4.00	5.93
Sex of child	Male	813	.22	1.91	-3.99	5.93
	Female	770	.31	2.03	-4.00	5.71
Marital duration of mother	Never married	30	.24	1.76	-3.64	3.90
	0-4	383	.28	1.99	-3.99	5.60
	5-9	465	.35	2.00	-4.00	5.93
	10-14	305	.09	1.98	-3.97	5.53
	15-19	220	.25	1.88	-3.98	5.71
	20-24	128	.44	1.92	-3.72	5.30
	25-29	45	.12	2.04	-3.69	3.85
Sex of household head	Male	1,434	.26	1.99	-4.00	5.93
	Female	149	.31	1.81	-3.64	4.85
Child's age	0-8 months	348	.45	2.15	-3.87	5.93
	9-17 months	402	.12	2.15	-3.98	5.71
	18-26 months	419	.27	1.87	-4.00	5.68
	27-36 months	414	.24	1.70	-3.99	5.71
Source of drinking water	Piped into residence	147	.27	1.90	-3.98	5.32
	Public tap	233	.33	1.97	-3.87	5.50
	Well in residence	251	.25	2.16	-3.98	5.71
	Public well	272	.14	2.05	-3.99	5.68
	River, stream	352	.45	1.90	-3.64	5.71
	Borehole	187	.05	1.78	-4.00	5.30
	Other sources	117	.36	1.91	-3.97	5.93
All children		1,583	.26	1.97	-4.00	5.93

Source: Author's Calculations from Nigerian Demographic and Health Survey.

Table A.4. Descriptive statistics of body mass indexes of selected women aged 15 to 49, by background characteristics, Nigeria

Background Characteristic	Number of Women	Mean	Standard Deviation	Minimum	Maximum	
Region	Urban	683	23.15	5.23	12.25	53.56
	Rural	1,855	22.82	5.77	12.35	59.57
	Northeast	599	22.10	6.23	12.35	58.64
	Northwest	441	23.20	7.03	12.35	59.57
	Southeast	478	23.98	4.71	15.98	46.93
	Southwest	521	22.28	5.19	12.81	57.09
	Central	499	23.24	4.41	12.25	53.63
Location	Capital, large city	123	23.94	4.91	17.36	43.76
	Small city	364	23.25	5.98	12.25	53.56
	Town	196	22.48	3.61	13.27	33.97
	Countryside	1,855	22.82	5.77	12.35	59.57
Education	No education	1,244	22.51	5.94	12.25	59.57
	Primary	629	22.82	4.83	12.81	53.63
	Secondary	583	23.56	5.60	13.27	58.64
	Higher	82	25.07	6.02	15.41	48.62
Age group of women	15–19	233	22.68	6.26	13.84	58.64
	20–24	553	22.66	5.71	12.35	59.57
	25–29	700	22.87	5.78	12.25	57.09
	30–34	541	23.05	5.24	12.75	58.07
	35–39	348	23.32	5.83	12.35	51.90
	40–44	115	22.89	4.69	12.35	47.64
	45–49	48	22.78	4.11	17.63	35.55
Ethnicity	Hausa	688	22.98	6.35	12.35	59.57
	Igbo	287	24.13	5.21	12.81	46.93
	Yoruba	433	21.98	4.49	13.27	48.63
	Other ethnicity	1,073	22.79	5.48	12.25	58.64
Sex of child	Male	1,262	22.75	5.30	12.35	59.57
	Female	1,276	23.06	5.94	12.25	59.57
Marital duration (years)	Never married	50	23.54	5.06	16.44	47.64
	0–4	578	22.69	5.49	13.27	58.64
	5–9	683	23.04	5.87	12.37	59.57
	10–14	526	22.86	5.56	12.25	54.12
	15–19	370	22.96	5.57	12.35	58.07
	20–24	233	22.79	6.02	12.35	51.90
	25–29	81	23.37	4.71	13.01	42.15
	30+	17	22.90	4.46	17.63	31.11
Sex of household head	Male	2,313	22.92	5.71	12.25	59.57
	Female	225	22.75	4.82	12.97	47.64
Child's age	0–8 months	632	22.96	5.55	13.01	58.64
	9–17 months	658	22.75	5.84	12.25	59.57
	18–26 months	564	22.72	4.82	13.06	54.12
	27–36 months	521	23.40	6.33	12.35	59.57
Source of drinking water	Piped into residence	253	23.55	5.55	12.97	48.62
	Public tap	321	23.47	5.86	12.25	50.22
	Well in residence	442	23.17	5.76	12.35	57.09
	Public well	521	22.30	7.11	12.35	59.57
	River, stream	540	22.80	4.56	13.22	53.63
	Borehole	243	22.61	4.57	15.42	46.55
	Other sources	184	22.77	4.15	14.69	34.53
All women		2,538	22.91	5.63	12.25	59.57

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Table A.5. Inequalities in child malnutrition, by demographic and socioeconomic groups, Nigeria

Background Characteristic	Height-for-Age (Stunting)	Weight-for-Age (Underweight)	Weight-for-Height (Wasting)
Residence			
National	0.0447	0.0343	0.0213
Urban	0.0442	0.0267	0.0177
Rural	0.0431	0.0371	0.0217
Within inequality	0.0425	0.0341	0.0206
Between inequality	0.0022	0.0002	0.0007
Within share (%)	95.08	99.42	96.71
Between share (%)	4.92	0.58	3.29
Region			
Northeast	0.0435	0.0436	0.0227
Northwest	0.0473	0.0354	0.0205
Southeast	0.0343	0.0239	0.0193
Southwest	0.0438	0.0199	0.0182
Central	0.0411	0.0291	0.0211
Within inequality	0.0416	0.0310	0.0205
Between inequality	0.0031	0.0033	0.0008
Within share (%)	93.06	90.38	96.24
Between share (%)	6.94	9.62	3.76
Sex of child			
Male	0.0452	0.0330	0.0202
Female	0.0395	0.0332	0.0224
Within inequality	0.0426	0.0331	0.0213
Between inequality	0.0021	0.0012	0.0000
Within share (%)	95.30	96.50	100.00
Between share (%)	4.70	3.50	0.00
Education of mother			
No education	0.0463	0.0375	0.0188
Primary	0.0404	0.0241	0.0231
Secondary	0.0376	0.0356	0.0221
Higher	0.0394	0.0119	0.0095
Within inequality	0.0424	0.0328	0.0203
Between inequality	0.0023	0.0015	0.0010
Within share (%)	94.85	95.63	95.31
Between share (%)	5.15	4.37	4.69
Sex of household head			
Male	0.0435	0.0359	0.0216
Female	0.0302	0.0272	0.0216
Within inequality	0.0424	0.0353	0.0209
Between inequality	0.0023	-0.0010	0.0004
Within share (%)	94.85	102.92	98.12
Between share (%)	5.15	-2.92	1.88
Location			
Capital, large city	0.0298	0.0203	0.0062
Small city	0.0472	0.0321	0.0112
Town	0.0419	0.0244	0.0204
Countryside	0.0421	0.0371	0.0217
Within inequality	0.0423	0.0341	0.0199

Table A.5. Continued

Background Characteristic	Height-for-Age (Stunting)	Weight-for-Age (Underweight)	Weight-for-Height (Wasting)
Location			
Between inequality	0.0024	0.0002	0.0014
Within share (%)	94.63	99.42	93.43
Between share (%)	5.37	0.58	6.57
Ethnicity			
Hausa	0.0448	0.0371	0.0239
Igbo	0.0399	0.0263	0.0159
Yoruba	0.0429	0.0197	0.0205
Other ethnicity	0.0404	0.0361	0.0181
Within inequality	0.0419	0.0315	0.0202
Between inequality	0.0028	0.0028	0.0011
Within share (%)	93.74	91.84	94.84
Between share (%)	6.26	8.16	5.16
Source of drinking water			
Piped into residence	0.0353	0.0400	0.0205
Public tap	0.0430	0.0330	0.0174
Well in residence	0.0524	0.0357	0.0197
Public well	0.0418	0.0409	0.0177
River, stream	0.0420	0.0221	0.0174
Borehole	0.0425	0.0248	0.0198
Other sources	0.0372	0.0172	0.0299
Within inequality	0.0428	0.0316	0.0192
Between inequality	0.0019	0.0027	0.0021
Within share (%)	95.75	92.13	90.14
Between share (%)	4.25	7.87	9.86
Age of child			
0–8 months	0.0397	0.0328	0.0211
9–17 months	0.0417	0.0386	0.0194
18–26 months	0.0413	0.0321	0.0215
27–35 months	0.0438	0.0313	0.0197
Within inequality	0.0419	0.0340	0.0204
Between inequality	0.0028	0.0003	0.0009
Within share (%)	93.74	99.13	95.77
Between share (%)	6.26	0.87	4.23

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Table A.6. Inequalities in nutritional status of women, by demographic and socioeconomic groups, Nigeria

	Theil L	Theil T
Residence		
Urban	0.0241	0.0212
Rural	0.0256	0.0290
Within inequality	0.0249	0.0269
Between inequality	0.0002	0.0004
Within share	99.20	98.53
Between share	0.80	1.47
Region		
Northeast	0.0321	0.0349
Northwest	0.0359	0.0396
Southeast	0.0182	0.0171
Southwest	0.0228	0.0228
Central	0.0140	0.0184
Within inequality	0.0247	0.0265
Between inequality	0.0004	0.0008
Within share (%)	98.41	97.07
Between share (%)	1.59	2.93
Education		
No education	0.0283	0.0310
Primary	0.0186	0.0212
Secondary	0.0249	0.0231
Higher	0.0260	0.0250
Within inequality	0.0250	0.0267
Between inequality	0.0001	0.0006
Within share (%)	99.60	97.80
Between share (%)	0.40	2.20
Age		
15–19	0.0303	0.0317
20–24	0.0273	0.0259
25–29	0.0274	0.0268
30–34	0.0243	0.0216
35–39	0.0267	0.0295
40–44	0.0191	0.0192
45–49	0.0153	0.0142
Within inequality	0.0263	0.0257
Between inequality	–0.0012	0.0016
Within share (%)	104.78	94.14
Between share (%)	–4.78	5.86
Ethnicity		
Hausa	0.0311	0.0323
Igbo	0.0196	0.0233
Yoruba	0.0185	0.0178
Other ethnicity	0.0249	0.0257
Within inequality	0.0249	0.0259
Between inequality	0.0002	0.0014
Within share (%)	99.20	94.87
Between share (%)	0.80	5.13
Between share (%)	0.80	5.13

Table A.6. Continued

	Theil L	Theil T
Regional urban–rural		
Northeast urban	0.0314	0.0302
Northwest urban	0.0265	0.0263
Southeast urban	0.0170	0.0130
Southwest urban	0.0183	0.0159
Central urban	0.0221	0.0238
Northeast rural	0.0309	0.0354
Northwest rural	0.0354	0.0433
Southeast rural	0.0163	0.0200
Southwest rural	0.0242	0.0310
Central rural	0.0151	0.0120
Within inequality	0.0241	0.0265
Between inequality	0.0010	0.0008
Within share (%)	96.02	97.07
Between share (%)	3.98	2.93
Location		
Capital, large city	0.0169	0.0209
Small city	0.0300	0.0275
Town	0.0136	0.0119
Countryside	0.0256	0.0290
Within inequality	0.0249	0.0271
Between inequality	0.0002	0.0002
Within share (%)	99.20	99.27
Between share (%)	0.80	0.73
Marital duration		
Never married	0.0169	0.0219
0–4	0.0242	0.0251
5–9	0.0246	0.0303
10–14	0.0267	0.0247
15–19	0.0275	0.0252
20–24	0.0296	0.0308
25–29	0.0196	0.0177
30+	0.0166	0.0173
Within inequality	0.0255	0.0266
Between inequality	–0.0004	0.0007
Within share (%)	101.59	97.44
Between share (%)	–1.59	2.56
Source of drinking water		
Piped into residence	0.0249	0.0260
Public tap	0.0268	0.0282
Well in residence	0.0243	0.0266
Public well	0.0388	0.0429
River, stream	0.0179	0.0185
Borehole	0.0172	0.0188
Other sources	0.0163	0.0162
Within inequality	0.0250	0.0268
Between inequality	0.0001	0.0005
Within share (%)	99.60	98.17
Between share (%)	0.40	1.83

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Table A.7. Relationship between inequality in stunting and prevalence of stunting, Nigeria

Number	Background characteristic	Theil L stunting	Prevalence of stunting (%)	Rank inequality	Rank prevalence
1	National	0.0447	45.60	29	17
2	Urban residence	0.0442	41.76	28	14
3	Rural residence	0.0431	47.22	23	22
4	Northeast region	0.0435	55.30	25	31
5	Northwest region	0.0473	56.90	34	34
6	Southeast region	0.0343	35.25	3	3
7	Southwest region	0.0438	38.82	27	6
8	Central region	0.0411	53.36	13	30
9	Capital city location	0.0298	32.29	1	2
10	Small city location	0.0472	47.42	33	24
11	Town location	0.0419	39.34	17	8
12	Countryside location	0.0421	27.22	19	22
13	No education of mothers	0.0463	56.15	32	33
14	Primary education of mothers	0.0404	39.90	12	10
15	Secondary education of mothers	0.0376	39.09	6	7
16	Higher education of mothers	0.0394	36.92	7	5
17	Male children	0.0452	48.44	31	26
18	Female children	0.0395	42.68	8	15
19	Piped source of drinking water into residence	0.0353	51.13	4	28
20	Public tap source of drinking water	0.0430	41.28	22	13
21	Well source of drinking water in residence	0.0524	50.50	35	27
22	Public well source of drinking water	0.0418	46.89	16	20
23	River stream source of drinking water	0.0420	47.25	18	23
24	Borehole source of drinking water	0.0425	39.67	20	9
25	Other sources of drinking water	0.0372	41.28	5	13
26	Household head is male	0.0435	46.19	25	19
27	Household head is female	0.0302	40.14	2	11
28	Hausa ethnicity	0.0448	60.24	30	35
29	Igbo ethnicity	0.0399	35.37	10	4
30	Yoruba ethnicity	0.0429	42.77	21	16
31	Other ethnicities	0.0404	46.08	12	18
32	0-8 months old children	0.0397	25.51	9	1
33	9-17 months old children	0.0417	47.98	15	25
34	18-26 months old children	0.0413	55.53	14	32
35	27-35 months old children	0.0438	51.74	27	29
Pearson correlation of Theil L stunting and prevalence of stunting					
			Theil L stunting		Prevalence of stunting
	Theil L stunting	Pearson correlation	1		.529**
		Sig. (2-tailed)			.001
		N	35		35
	Prevalence of stunting	Pearson correlation	.529**		1
		Sig. (2-tailed)	.001		
		N	35		35

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Note: **Correlation is significant at the 0.01 level (2-tailed).

Table A.8. Relationship between inequality in underweight and prevalence of underweight, Nigeria

Number	Background characteristic	Theil L underweight	Prevalence of underweight (%)	Rank inequality	Rank prevalence
1	National	0.0343	27.54	22	20
2	Urban residence	0.0267	27.15	12	19
3	Rural residence	0.0371	27.71	29	22
4	Northeast region	0.0436	38.41	35	32
5	Northwest region	0.0354	45.69	23	34
6	Southeast region	0.0239	18.03	7	4
7	Southwest region	0.0199	24.94	4	14
8	Central region	0.0291	24.38	14	12
9	Capital city location	0.0203	17.71	5	3
10	Small city location	0.0321	22.07	17	8
11	Town location	0.0244	43.44	9	33
12	Countryside location	0.0371	27.71	29	22
13	No education of mothers	0.0375	36.70	31	31
14	Primary education of mothers	0.0241	24.14	8	10
15	Secondary education of mothers	0.0356	19.77	24	6
16	Higher education of mothers	0.0119	24.62	1	13
17	Male children	0.0330	29.36	20	26
18	Female children	0.0332	25.66	21	16
19	Piped source of drinking water into residence	0.0400	26.32	33	17
20	Public tap source of drinking water	0.0330	26.61	20	18
21	Well source of drinking water in residence	0.0357	35.15	25	30
22	Public well source of drinking water	0.0409	32.78	34	28
23	River stream source of drinking water	0.0221	22.90	6	9
24	Borehole source of drinking water	0.0248	25.00	10	15
25	Other sources of drinking water	0.0172	22.02	2	7
26	Household head is male	0.0359	28.46	26	25
27	Household head is female	0.0272	19.01	13	5
28	Hausa ethnicity	0.0371	45.78	29	35
29	Igbo ethnicity	0.0263	16.59	11	2
30	Yoruba ethnicity	0.0197	27.73	3	23
31	Other ethnicities	0.0361	24.21	27	11
32	0-8 months old children	0.0328	15.84	18	1
33	9-17 months old children	0.0386	34.50	32	29
34	18-26 months old children	0.0321	28.30	17	24
35	27-35 months old children	0.0313	3.56	15	27

Pearson correlation of Theil L underweight and prevalence of underweight

		Theil L underweight	Prevalence of underweight
Theil L underweight	Pearson correlation	1	.432**
	Sig. (2-tailed)		.01
	N	35	35
Prevalence of underweight	Pearson correlation	.432**	1
	Sig. (2-tailed)	.01	
	N	35	35

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Note: **Correlation is significant at the 0.01 level (2-tailed).

Table A.9. Relationship between inequality in wasting and prevalence of wasting, Nigeria

Number	Background characteristic	Theil L wasting	Prevalence of wasting (%)	Rank inequality	Rank prevalence
1	National	0.0213	12.76	24	21
2	Urban residence	0.0177	11.78	8	16
3	Rural residence	0.0217	13.17	29	25
4	Northeast region	0.0227	16.44	32	30
5	Northwest region	0.0205	20.75	20	35
6	Southeast region	0.0193	8.06	12	3
7	Southwest region	0.0182	12.50	10	20
8	Central region	0.0211	10.17	23	7
9	Capital city location	0.0062	7.77	1	2
10	Small city location	0.0112	8.60	3	5
11	Town location	0.0204	19.58	18	34
12	Countryside location	0.0217	13.17	29	25
13	No education of mothers	0.0188	15.21	11	28
14	Primary education of mothers	0.0231	12.94	33	22
15	Secondary education of mothers	0.0221	9.30	30	6
16	Higher education of mothers	0.0095	10.61	2	10
17	Male children	0.0202	11.93	17	17
18	Female children	0.0224	13.64	31	26
19	Piped source of drinking water into residence	0.0205	10.88	20	14
20	Public tap source of drinking water	0.0174	10.73	6	12
21	Well source of drinking water in residence	0.0197	17.93	15	31
22	Public well source of drinking water	0.0177	15.81	8	29
23	River stream source of drinking water	0.0174	10.23	6	8
24	Borehole source of drinking water	0.0198	10.70	16	11
25	Other sources of drinking water	0.0299	10.26	35	9
26	Household head is male	0.0216	12.97	27	23
27	Household head is female	0.0216	10.74	27	13
28	Hausa ethnicity	0.0239	18.10	34	32
29	Igbo ethnicity	0.0159	8.19	4	4
30	Yoruba ethnicity	0.0205	12.28	20	18
31	Other ethnicities	0.0181	11.57	9	15
32	0-8 months old children	0.0211	13.79	23	27
33	9-17 months old children	0.0194	18.41	13	33
34	18-26 months old children	0.0215	12.41	25	19
35	27-35 months old children	0.0197	6.76	15	1

Pearson correlation of Theil L wasting and prevalence of wasting

		Theil L wasting	Prevalence of wasting
Theil L wasting	Pearson correlation	1	.319
	Sig. (2-tailed)		.062
	<i>N</i>	35	35
Prevalence of wasting	Pearson correlation	.319	1
	Sig. (2-tailed)	.062	
	<i>N</i>	35	35

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Table A.10. Pearson correlations of indicators of child malnutrition, by background characteristics, Nigeria

		Prevalence of Stunting	Prevalence of Underweight	Prevalence of Wasting
Prevalence of stunting	Pearson correlation	—	.710**	.415*
	Significance (two-tailed)		.000	.013
	<i>N</i>	35	35	35
Prevalence of underweight	Pearson correlation	.710**	—	.826**
	Significance (two-tailed)	.000		.000
	<i>N</i>	35	35	35
Prevalence of wasting	Pearson correlation	.415*	.826**	—
	Significance (two-tailed)	.013	.000	
	<i>N</i>	35	35	35

Source: Author's calculations from the Nigerian Demographic and Health Survey.

Notes: *Correlation is significant at the .05 level (two-tailed). **Correlation is significant at the .01 level (two-tailed).

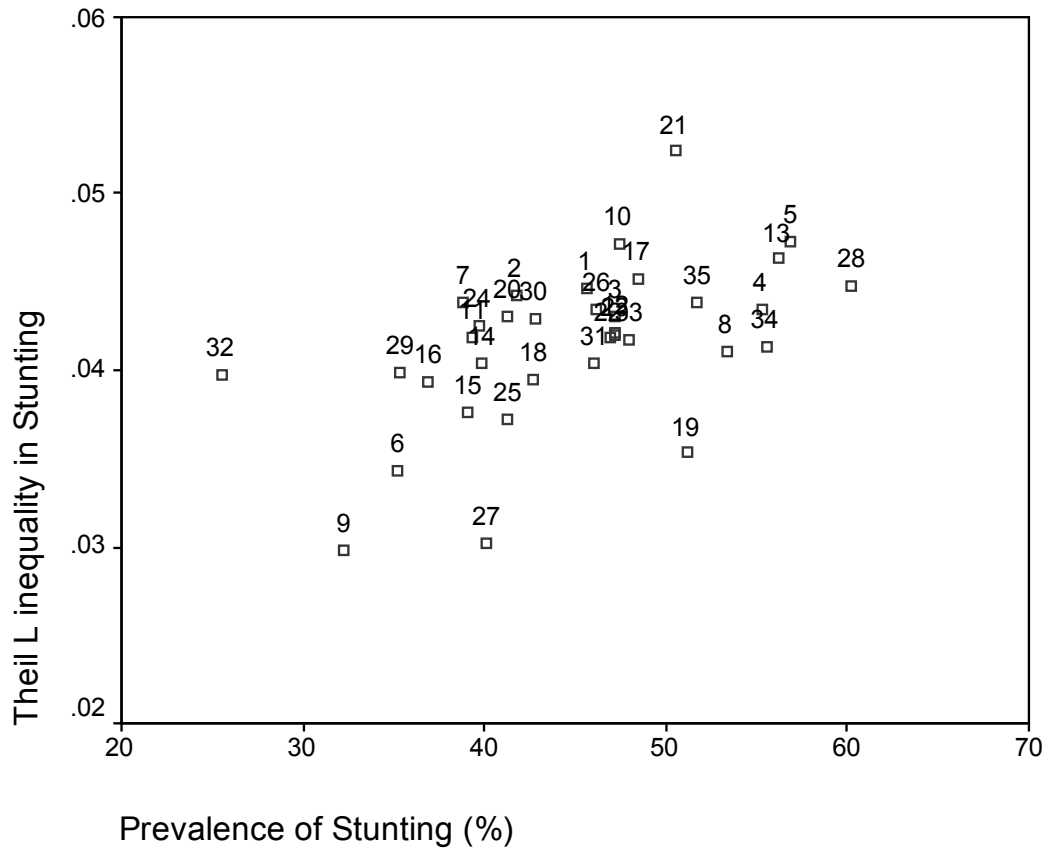
Table A.11. Pearson correlations of inequalities in indicators of child malnutrition, by background characteristics, Nigeria

		Theil L Stunting	Theil L Underweight	Theil L Wasting
Theil L stunting	Pearson correlation	—	.341*	.115
	Significance (two-tailed)		.045	.510
	<i>N</i>	35	35	35
Theil L underweight	Pearson correlation	.341*	—	.285
	Significance (two-tailed)	.045		.098
	<i>N</i>	35	35	35
Theil L wasting	Pearson correlation	.115	.285	—
	Significance (two-tailed)	.510	.098	
	<i>N</i>	35	35	35

Source: Author's calculations from the Nigerian Demographic and Health Survey.

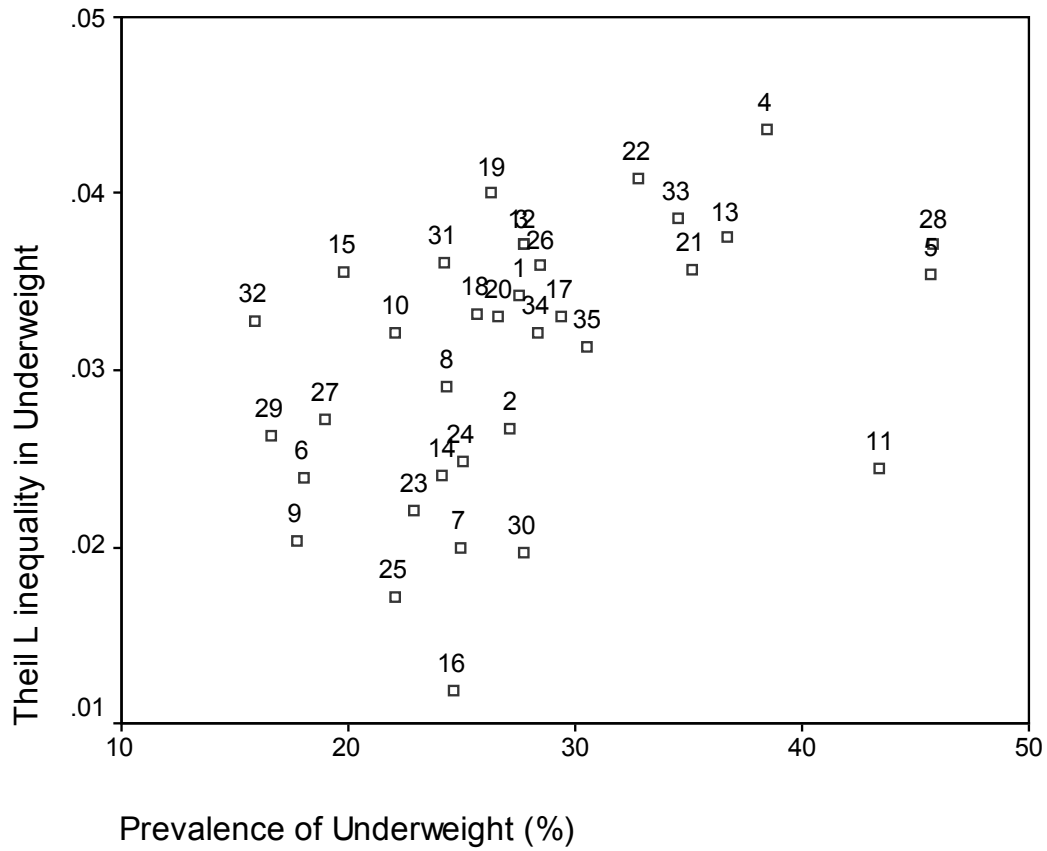
Note: *Correlation is significant at the .05 level (two-tailed).

Figure A.1. Scatter plot of inequality in stunting versus prevalence of stunting, Nigeria



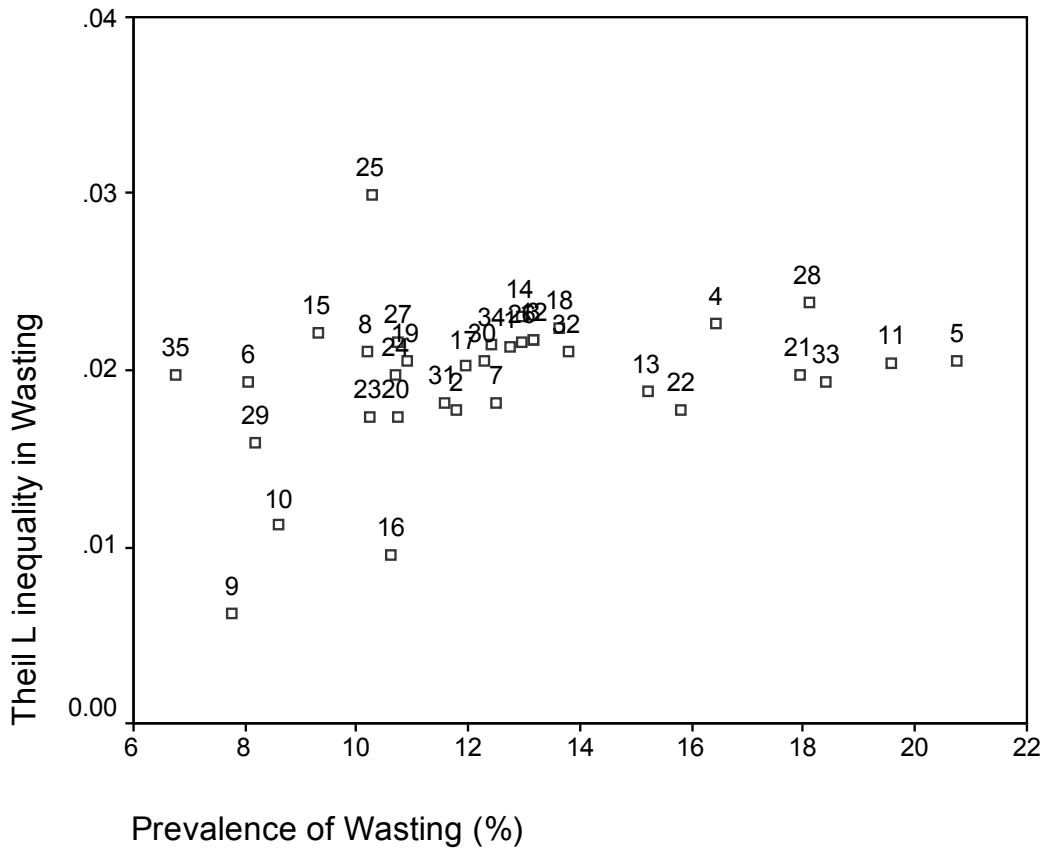
Source: Author's calculations from the Nigerian Demographic and Health Survey.

Figure A.2. Scatter plot of inequality in underweight versus prevalence of underweight, Nigeria



Source: Author's calculations from the Nigerian Demographic and Health Survey.

Figure A.3. Scatter plot of inequality in wasting versus prevalence of wasting, Nigeria



Source: Author's calculations from the Nigerian Demographic and Health Survey.

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