Impact of Parental Resilience on Child Malnutrition Outcomes in Nigeria

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Abstract

Child malnutrition has been a major cause of illnesses and diseases, which increases child mortality and creates a burden on the parents. Among the malnourished children, 20.97% were stunted only, 1.13% were wasted only, and 1.22% were underweight only. The study revealed that the northern geopolitical zones recorded the highest number of malnourished children than the southern zones. There was a negative relationship between child malnutrition and parental resilience. The northeast zone had the most malnourished children, while the southsouth zone had the least. The probability of being malnourished was highest among the northern geopolitical zones. Parental resilience had a strong relationship with child malnutrition. The study posited that the parents in the southwest were the most resilient to child malnutrition, while parents in the northwest had the least resilience to child malnutrition. Mother's education and resilience index influenced child malnutrition in Nigeria and in most of the geopolitical zones. The study recommends the significant role of Non-governmental organisation in encouraging adult education among parents, as well as engaging in community self-help projects to boost the basic infrastructure needs of residents.

Keywords: Child malnutrition; parental resilience; Nigeria; Geopolitical Zones; probit regression; Principal Component Analysis; Analysis of Variance.

1.0 Introduction

Malnutrition, poverty, unemployment, and food insecurity are common manifestations of economic challenges and insecurity facing Nigeria. These problems are hampering the growth of children and youths as well as their ability to be creative and innovative (World Bank, 2022). According to United Nations High Commission for Refugees (2023), insurgencies, terrorism activities from Boko Haram and its allied, other non-state armed groups, as well as clashes between herders and farmers, have pushed some 3.0 million Nigerians, mostly mothers (as of November 2021) out of their homes depriving them of means of livelihood. The ability of the vulnerable, most especially the mother and children to withstand the shocks brought about by human and non-human factors (climate change) and maintain a level of well-being is largely dependent on the covariates (varies from one individual to the other) and idiosyncratic factors (subject to the environment). The need for parents' resilience in order to ensure the survival of their children against diseases such as malnutrition in the face of these challenges cannot be overemphasized. A malnourished child will not be able to contribute to the growth and development of the country in the future. Even in difficult situations, resilient parents are better able to give their kids enough to eat, a place to live, and access to healthcare (Mariani-Wigley *et al.,* 2021).

The burden of child malnutrition is borne by the parents, especially the mother, who seeks to improve their children's quality of life. Parents exercise different capacities in coping with various shocks, such as malnutrition, showing resiliency. Resilient parents can adapt to changes, supporting their children (Widyawati *et al.,* 2022). Alinovi *et al*. (2010) defined resilience as the capacity to maintain a certain level of well-being despite shocks and stresses (Alinovi *et al.,* 2010) Resilience comes from the Latin word "resilire," which means to rebound, the ability to recover from shocks, bounce back, and even become better off (Yılmaz, 2017). Resilience is multifaceted and challenging to determine using one dimension, and there is no consensus on the method. A standard method used to measure resilience capacity is measuring each pillar of

its pillars. The pillars of resilience are Access to Basic Services, Assets, Sensitivity, and Adaptive Capacity (Errico *et al.,* 2022*)*. Access to basic services such as health, education, sanitation facilities, and electricity is determined by determining the income-generating ability of a household, risk exposure, and adaptation. Sensitivity measure; risk exposure, the extent to which a household's livelihood is affected by a specific shock, and resistance, which is the amount of shock a household can absorb before reaching the limit, Food and Agriculture Organisation (2016) . However, adaptive capacity is also as important as the other pillars in measuring resilience. Adaptive capacity depicts the ability to thrive in changing institutional frameworks, networks, and social systems (Errico *et al.,* 2022*)*.

Parental resilience is the capacity of the parents to respond to and recover from various difficulties positively (Bhattacharjee *et al*., 2022). Child malnutrition reduces the mother's productivity due to the time dedicated to caring for the child. This effect can also lead to dual forms of malnutrition involving both the child and either or both parents (El-Kishawi *et al*., 2016). Poor maternal health prevents mothers from actively engaging in income-generating activities, and likewise, malnourished mothers give birth to low-weight children, a significant determinant of malnutrition in children.

Measuring parental resilience to malnutrition will ensure the avoidance of long-lasting adverse development consequences of child malnutrition. The findings of this study would help the government in enacting new policies and programmes that can help improve parental resilience and child nutritional status by aligning with Millennium Development Goal 4 and Sustainable Development Goal 2.2, which is to reduce child mortality caused by under-nutrition and seeks to end all forms of malnutrition in children under five years of age, respectively. Also, it is expected that the findings would bring about improved resource management by allowing policymakers to channel resources towards the most vulnerable populations; the malnourished children and parents with malnourished children in the different geopolitical zones of Nigeria with a high prevalence of child malnutrition. This study would offer essential knowledge about the factors that influence child malnutrition and provide knowledge about variables that contribute to the parental resilience to child malnutrition while serving as a base for further studies. There is no gainsaying that there is a dearth of literature in parental resilience to child malnutrition. It is expected that this study will fill knowledge gap and providing answers to the following research questions:

(i) What are the profiles of child malnutrition status by children and parents' socioeconomic characteristics in Nigeria?
(ii) What are the parental resilience capacity to child malnutrition in Nigeria?
(iii) What is the effect of parental resilience on child malnutrition in Nigeria?
(iv) Is there a significant difference between parental resilience to child malnutrition among the geopolitical zones in Nigeria?

2.0 Theoretical Framework and Literature Review

The family resilience theory and the social production of health underpin this study. The family resilience theory sees the family as a functional system affected by highly stressful situations and social contexts, allowing for positive member adaptation and strengthening the family

(Walsh, 2016). In cases of shocks and stress which directly affects children and indirectly affects the parents and family as a whole, the family provides financial security and practical support and fosters a sense of belonging using organised resources and family-based healthcare system such as health insurance for resiliency. Family resilience places each family within its unique resources and challenges, unlike models of fundamental family functioning that are out of context and under non-stress situations (Walsh, 1996).

Several studies have used biochemical markers (Zhang *et al*., 2017; Combs *et al*., 2013; Kwena and Wakhisi, 2012), dietary intake (Thowfeek *et al*., 2023; Burrows *et al*., 2010) and clinical assessment (Xu and Vincent, 2020; Jeejeebhoy, 2015) to measure child malnutrition. However, the biochemical marker has the limitations of result variability, outside influences that may distort data, and the difficulty of interpreting the findings (Cliffsnotes, 2025); dietary intake uses 24-hour recall, which may be inaccurate due to forgetfulness or deliberate withdrawal of information (Lwanga *et al.,* 2016) while clinical assessment is identified with symptoms that are not specific to a case and may not be as a result of malnutrition (Shrivastava *et al.,* 2014). This study used the World Health Organization Child Growth Standard Z scores because it is an international standard that uses body measurement, that is, anthropometry, which is accurate across the whole malnutrition and body range (Blössner *et al.,* 2005) and can be subjected to summary statistics (Seetharaman et al., 2007). Factor Analysis has been used to generate an index in other studies, but it is reliable only in smaller sample sizes and has difficulty interpreting the factors (Fabrigar *et al.,* 1999). This study used the Principal Component because it is the most widely used method and helps minimise dataset dimensionality while retaining much variability in statistical data (Jollife *et al.,* 2016).

To measure the determinants of binary dependent variables, several works of literature have used linear probability models whose probabilities are not constrained between 0 and 1 (Murraylax, 2012) and Logistic regression, which lacks a clear explanation for response probability (Begg Md, 2007) its coefficient requires log odds which is more complex than using marginal effect directly in probit (Stefan *et al.,* 2009). Probit regression was used because it has non-linear probabilities between 0 and 1 (Carpena F, 2016), and its coefficients are more easily interpreted than logit (Stefan *et al.,* 2009). Analysis of Variance (Murendo *et al*., 2021)was used to assess whether there are any statistically significant differences in the parental resilience to child malnutrition among the geopolitical zones (Laerd, 2018).

Analytical Framework for Parental resilience index generated with Principal Component Analysis (PCA) and grouped using adapted Resilience Index Measurement Analysis (RIMA) Pillars

Principal Component Analysis is a method of data reduction that can be used to reduce the dimensionality of a data set by identifying a new set of variables, referred to as uncorrelated principal components, retain most sample data, and are ranked according to the percentage of the total data that each component explains (Errico *et al.,* 2022*)*. PCA can also help reduce the variables in a regression study by focusing on the essential factors.
PCA is specified as;

$$X = VP + E \quad \text{..... (12)}$$

Where:

V represents the matrix of principal components

P represents the matrix describing the influence of each original variable on the principal components

E represents the residual matrix containing information not described by principal components

The conceptual model to group resilience is based on the following equation;

$$RI = f(ABS + AST + AC + \varepsilon) \quad \text{..... (13)}$$

Where:

ABS represents Access to Basic Services, such as water, electricity, and toilet facilities

AST represents Asset Ownership, such as house, land, and vehicle

AC represents Adaptive capacity, such as education and health insurance

3.0 Materials and Methods

3.1 Study Area

Nigeria was the study area. Nigeria is a country in West Africa with a total land area of 923,768 km^2 (356,669 sq. mi). It has 36 states and one federal capital territory, divided into 774 local government areas (LGAs). Nigeria is divided into six geopolitical zones; North Central, North East, North West, South East, South-South and South West, based on the grouping of states with close historical, cultural, and political relationships and similar socioeconomic patterns and levels of development (Nwosu and Orji, 2017). Nigerian vegetation distribution can be broadly categorized from south to north as follows: Guinea savanna (woodland and tall grass savanna, Montane), Sudan savanna (short grass savanna), Sahel savanna (Maginal savanna), rain belt (rainforest), and coastline (mangrove, fresh water swamp) (CBN Annual Report, 1999). As of 2022, 37.99% of the population engaged in agriculture. Yam, cocoyam, cassava, maize, melon, and vegetables and palm tree and some of the crops grown in the southern agroclimatic zone (Ndaeyo *et al.,* 2001) while millet, sorghum, guinea corn, sesame and groundnut are cultivated in the northern zone (Ochuko, 2015). Poverty rate and child malnutrition are high in the northern agroclimatic zone (NBS, 2010; IRC, 2024). According to International Rescue Committee Report (2024), high child malnutrition in the north was attributed to armed conflicts which forced countless families from their homes, disrupting their ability to farm and earn a livelihood.

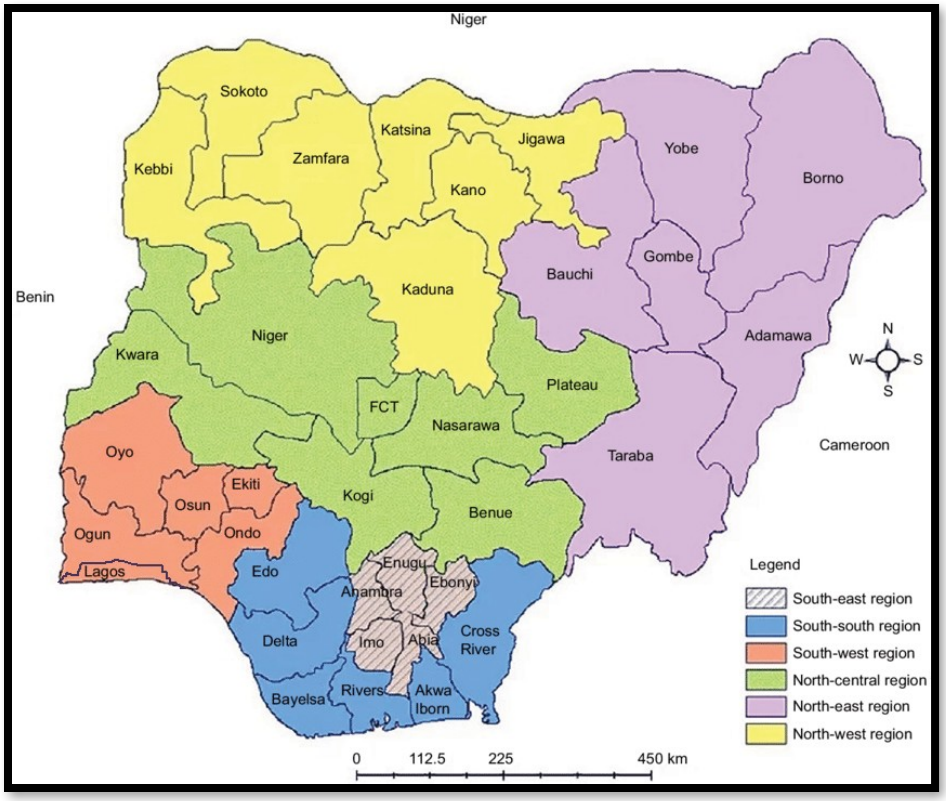

Figure 1: Map of Nigeria showing Geopolitical Zones

3.2 Source of data and Sampling procedure used for the data collection

The study utilised secondary data sourced from the 2018 Demographic and Health Survey data by the National Population Commission. Based on the DHS Program's standard Demographic and Health Survey (DHS-7) questionnaires, the questionnaires were adapted to reflect the population and health issues relevant to Nigeria (Nigeria Population Commission (NPC) and International Children Fund (ICF), 2018). The information extracted from the data includes the age of children (0-59 months), sex, birth order, height for age z-scores, weight for height z-scores, weight for age z-scores, mother's age, father's age, mother's education, father's education, household size, father's occupation, assets, basic amenities and the region respondents fall into. The total households in the survey was 42,000 households in Nigeria (NPC and ICF, 2018). After cleaning the data, 14,689 households that cut across the six (6) geopolitical zones resulting were used for further analysis.

3.3 Analytical Techniques

Descriptive statistics, Principal Component Analysis and Probit regression were employed to achieve the objective of the study. Each of these analytical techniques is explained in the following subsections.

3.3.1 Descriptive statistics and WHO child growth z-scores

Descriptive statistics was used to profile child malnutrition in Nigeria by socioeconomic characteristics like the child's age, sex, birth order and Mother and father's characteristics, such as age, employment status, education, occupation and household size. The descriptive statistics include charts, tables, frequency distribution and standard deviation. Child malnutrition was determined using the World Health Organisation (length/height-for-age, 2021) Child Growth Standards z-scores in the DHS data with a standard cut-off of less than or equal to 2.00 standard deviation. This cut-off is in line with the WHO recommendations. Children are classified as stunted, measured by Height for Age (HAZ); wasted, measured with Weight for Height (WHZ); and underweighted, measured by weight for age (WAZ). Children exhibiting stunting, wasting, underweight or a combination of two or the three categories are classified as malnourished, while those without any anthropometric failure are categorised as normal.

3.3.2 Principal Component Analysis and adapted Resilience Index Measurement Analysis (RIMA)

Following the Adapted Resilience Index Measurement Analysis (FAO, 2016), Principal Component Analysis was used to generate the parental resilience index using components that contribute to resilience of household. The resilience indices generated were grouped into two categories: Low resilience (negative value) and high resilience (positive value).

3.3.3 Probit regression

Probit regression was used to determine the effect of parental resilience on child malnutrition. The explicit model is given as:

$$Y=\beta_0+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\beta_4 X_4+\beta_5 X_5+\beta_6 X_6+\beta_7 X_7+\beta_8 X_8+\beta_9 X_9+\beta_{10} X_{10}+\beta_{11} X_{11} \quad (26)$$

Where Y represents the child malnutrition status (Normal = 0, Malnourished = 1), β_0 represents the constant term, X_1 represents the parental resilience Index, X_2 represents the child's age (months), X_3 represents the child's sex (1= male, 0= female: male was used as one because there are more male malnourished child), X_4 represents the birth order (number), X_5 represents the mother's age (years), X_6 represents the father's age (years), X_7 represents the mother's education (0= no formal education, 1= primary education, 2= secondary education, 3= higher education), X_8 represents the father's education (0= no formal education, 1=primary education, 2= secondary education, 3=higher education), X_9 represents the household size, X_{10} represents the father's occupation (0=unemployed, 1=professional/technical/managerial, 2=

clerical, 3= sales, 4= agricultural, 5= services, 6= skilled and unskilled manual) X_{11} represents the Geopolitical Zones (1= North Central, 2= North East, 3= North West, 4= South East, 5= South-South, 6= South West).

The analysis was carried out (same model) using the pooled data as well as for each geopolitical zone in Nigeria. Note that variables X_7 , X_8 , X_{10} and X_{11} were operationalized using base categorization following Beni *et al.* (2024); Croft *et al*. (2023); Nankinga *et al*. (2019). In: X_7 no formal education was the base category, X_8 no formal education was the base category X_{10} unemployed was the base category, X_{11} North Central was used as the base category

4.0 Results and Discussion

4.1 Socioeconomic characteristics of respondents

The subsection explains the socioeconomic characteristics (age of parents, sex, educational status (mother and father), age of child, household size, order of birth, parental resilience and child malnutrition (stunted, wasting and underweight). Measures of central tendency (mean, median and mode) and dispersion (standard deviation, variance and skewness), tables and charts were used to profile the characteristics. Also, parental resilience and child malnutrition were profiled by the socioeconomic characteristics of the respondents.

4.1.1 Distribution of child malnutrition status

The study found that 43.53% of children are malnourished, while 56.47% are normal. Among the prevalence of malnutrition categories, the children exhibited one stunting, wasting, underweight, or a combination of two or the three categories (see Fig. 1). The prevalence of stunting was the highest (20.97%).

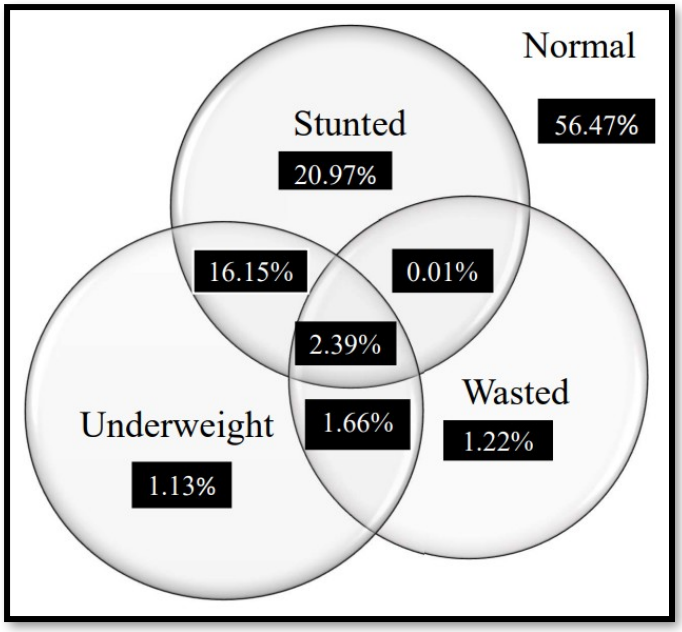

Figure 2: Disaggregation of child malnutrition status in Nigeria

Table 1 shows that the northern zones had the highest number of malnourished, stunted only, wasted only and underweight only children. Specifically, the northeast zone had the highest number of stunted, wasted, and underweight children; 52.13%, 65.67%, and 50.60%, respectively. The southsouth zone recorded the lowest percentage (4.13%) of malnourished children. An increase in the number of malnourished children in the northeast may be as a result of increased population and conflict in the area. This result corroborates (Kehinde *et al*., 2021) findings, who stated that stunting as a result of the inability to get adequate food for an extended period coupled with infections is highest in the northern zone of Nigeria due to internal displacements caused by insurgency and arms conflict where the children and women are most vulnerable.

Table 1: Distribution of child malnutrition by Geopolitical Zones

Geopolitical Zones	Stunted only		Wasted only		Underweight only		Total Malnourished	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
North Central	232	5.03	25	9.33	13	5.22	462	4.83
North East	2,402	52.13	176	65.67	126	50.60	4997	52.25
North West	1,162	25.22	22	8.21	38	15.26	2623	27.43
South East	235	5.10	17	6.34	16	6.43	485	5.07
South-South	233	5.06	14	5.22	13	5.22	395	4.13
South West	344	7.47	14	5.22	43	17.27	602	6.29
Total	**4608**	**100**	**268**	**100**	**249**	**100**	**9564**	**100**

4.1.2 Distribution of child malnutrition status socioeconomic characteristics of children

Children between the ages of 24-47 months had the highest percentage of malnourished children (50.52%). Children under 24 months had the lowest percentage of malnourished children (23.33%) (see Appendix 1). This finding agrees with (Zewdie and Adebaw, 2013), who found that stunting is higher in children 24 months of age and above. This may be attributed to children under 24 months still being breastfed and receiving the required body nutrients (Jona, 2018). Male children were more malnourished (51.7%) than females (48.30%). This aligns with (Tafesse *et al.,* 2021) who reported that males have a higher stunting level which may be a result of the sex preference of the family. (Salawu *et al.,* 2020) stated that males have higher stunting levels because of the high energy requirement needed for physical activities such as running around the house, which is reduced in females. Children between the birth order categories of 1-5 have more malnourished children (79.38%), while children with birth order of 11-15 have less malnourished children (1.16%)(see Appendix 1). This result agrees with (Kaiser, 1974), who reported that children with lower birth order are more malnourished than those with higher birth order.

4.1.2 Distribution child malnutrition status socioeconomic characteristics of parents

Mothers between 26 and 35 years of age had the highest percentage of malnourished children (48.21%). The percentage of malnourished children was highest amongst fathers in the age bracket of 36 - 49 years (47.26%) and lowest amongst fathers aged between 15 and 25 (1.15%). Concerning education, the percentage of malnourished children is highest among mothers with no formal education (57.46%) and lowest in mothers with a higher level of education (2.89%) (see Appendix 1). This agrees with (Kassa *et al.,* 2017) who recorded many malnourished children among parents without education because of the lack of knowledge of child nutrition. Moreover, in terms of occupation, fathers who engaged in agriculture had more malnourished children (46.52%). This means that parents with agriculture as the primary source of livelihood are prone to having malnourished children. The drudgery associated with agriculture in Nigeria coupled with low productivity makes farmers; most especially rural farmers to be poor. Simphiwe *et al.* (2023) submitted that low agricultural productivity threatens the efforts to lessen poverty. Bhattacharjee *et al.* (2022) state that satisfaction with one's occupation gives peace of mind and the ability to deal with daily shocks. Farming households are more likely to have malnourished children because of poor income. An average farmers' income is insufficient to buy diverse food required that meets the nutrient requirement; therefore, they rely only on the food they produce (Salawu *et al*., 2020). Also, access to adaptive capacity and basic service were very low as majority of the parents lack access to these services (see Appendices 3 and 4).

4.2 Determination of parental resilience of respondents

The Kaiser-Meyer-Olkin (KMO) sample adequacy test determines whether the data are appropriate for PCA. The values for each aspect of parental resilience demonstrate that the study's data set is appropriate for PCA. KMO accepts a value ranging from 0 to 1 (see Table 2). While values above 0.5 are deemed sufficient for PCA application, smaller values imply that variables have little in common with PCA estimates (Kaiser, 1974). In other words, a high KMO number means that the principal components may account for a comparatively larger amount of the variance. All parental resilience pillars had a KMO value of more than 0.60, which denotes a moderate level of correlation between the selected variables in each domain. Therefore, using

PCA estimation to calculate the parental resilience index is appropriate. The first principal components explain 45%, 35% and 31% of the total variations of the indicators of the pillars, respectively.

The proportions of each indicator variable in the index derived are shown by the magnitude of the component's loading coefficients. Drinking water, toilet, electricity and cooking fuel variables in the access to basic services pillar have positive component loading coefficients of 0.40 and above, indicating that these variables strongly correlate with the indices generated (see Table 2). Variables with positive component loading coefficients are associated with higher parental resilience indices; conversely, variables with negative coefficients are associated with parental resilience indices. Similarly, the Assets ownership pillar had positive component loading greater than 0.10. The bicycle has a negative coefficient that indicates owning a bicycle does not necessarily improve resilience because it is a traditional method of transportation as against bikes, cars and trucks, which are more sophisticated and have positive component loadings. The mother's education, followed by the father's, contributes more to the adaptive capacity pillar with high positive component loading of 0.62 and 0.59. This aligns with (D'Errico *et al.,* 2018*)*, which stated that education is the most relevant variable for adaptive capacity. However, the negative sign of the father (wage earner) may imply the father's absence at home and less devotion to child care while prioritizing economic activity.

The resilience index generated from individual resilience components using PCA was grouped into two categories. The negative values were categorised as those without resilience while indexes with positive values were categorised as those with resilience. Also, 51.27% of the parents had resilience (positive resilience index), while 48.73% of the respondents were without resilience.

Table 2: Principal Component Analysis result of parental resilience (negative resilience index)

Variables	Component Loadings
Access to Basic Services	
Drinking water	0.40
Toilet	0.47
Elect	0.48
Cooking Fuel	0.49
Internet	0.40
The proportion of Variation Explained	0.45
The eigenvalue of the first component	2.23
Kaiser-Meyer-Olkin measure of sampling adequacy (KMO):	0.74
Assets Ownership	
Radio	0.38
TV	0.52
Fridge	0.45
Bicycle	-0.03
Bike	0.11
Car	0.34
Phone	0.44
Land	0.20
House	0.13
The proportion of Variation Explained	0.25
The eigenvalue of the first component	2.25
Kaiser-Meyer-Olkin measure of sampling adequacy (KMO):	0.65
Adaptive Capacity	
Mother's Education	0.62
Health Insurance	0.20
Father's Education	0.59
Father (Wage earner)	-0.02
Mother (Wage earner)	0.003
Account (Financial institution)	0.48
The proportion of Variation Explained	0.31
The eigenvalue of the first component	1.85
Kaiser-Meyer-Olkin measure of sampling adequacy (KMO):	0.60

4.3 Effect of parental resilience on child malnutrition in Nigeria

In the pooled data, the LR chi^2 (24) test for the probit regression indicates that at least one of the predictor's regression coefficients is not equal to zero. The log-likelihood of the fitted model was -13450.5, and the Pseudo R^2 was 0.106. These indicate a good fit for the model. The prob > chi^2 value of 0.00 ($p<0.01$) also reflects the model's goodness of fit. The significant variables at different levels in the model were the child's age, child's sex, birth order, mother's age, father's age, mother's education (primary education, secondary education, higher education), father's education (secondary education, higher education), household size, parental resilience index, father's occupation (professional/technical/managerial, clerical, sales, services, agricultural and skilled and unskilled manual), Geopolitical Zones (North East, North West and South West zone).

The parental resilience index had a negative relationship with child malnutrition. For every increase in the parent's resilience, the probability of child malnutrition decreases by 4.1%. This implies that malnutrition decreases with an increase in parental resilience. This explanation follows Haile *et al.* (2022) on the increase in resilience index increasing food security. The decrease in malnutrition with an increase in parent resilience could be because of more access to basic services, ownership of assets and increased adaptive capacity. This is in unison with Errico and Pietrelli's (2017) study on resilience and child malnutrition in Mali. They found a negative relationship between resilience and all forms of child malnutrition, including stunting, wasting and wasting and wasting underweight and the number of malnourished children parents have because of the ability to withstand child malnutrition through resilience. The result also showed that for every increase in the child's age, the likelihood of child malnutrition will increase by 0.2%. This aligns with (Wali *et al.,* 2020), who explained the increased malnutrition with child age due to transitioning from breastfeeding to weaning children as their age increases, thus reducing required nutrient intake. Moreover, the likelihood of child malnutrition would increase by 1.5% among male children. This aligns with (Nwosu and Orji, 2017), stating that male children have higher chances of being malnourished because female children are given more attention than males owing to the possibility of generating a high dowry, most especially in the northern part of Nigeria.

The positive relationship between childbirth order and child malnutrition implies that malnutrition increases with increasing birth order Thus, agreeing with Sarkar and Halder (2020) who found out that malnutrition is lower for first births than for subsequent births and increases consistently with increasing birth order for stunting, wasting and underweight. This may be because older children with lower birth order can grow faster and earn income for the family, hence being fed more nutritious food (Ghosh, 2020). Moreover, the negative relationship between the mother's age and the child malnutrition may be attributed to the increased nutritional knowledge, maturity and level of exposure with an increase in age. (Wemakor *et al*., 2018) corroborated this finding. They found that children of teenage mothers are eight times more likely to be stunted, three times more likely to be wasted and 13 times more likely to be underweight. This is because adolescent mothers can give birth to low birth-weight children malnourished because of the early marriage of the mothers. Moreover, the result showed that as the mother and father attained higher education, the likelihood of child malnutrition reduces. This may be because with advancement in education, exposure and nutrition knowledge also increase (Widyawati, 2022).

Furthermore, the study affirmed a positive association between household size and child malnutrition. This agrees with Drammeh *et al*. (2019) who posited that malnutrition is higher in households with more members because they tend to compete for limited resources. They develop strategies to manage by consuming a lower quantity of food with reduced quality causing malnutrition (Ihab *et al.,* 2015). The result on the effect of GPZ on child malnutrition showed that the probability of child malnutrition was highest in the northwest (18.9%) compared to the northcentral. According to (Dunn., 2018), the surge in child malnutrition in the northeast results from the Boko haram insurgency and other conflicts; he claimed that if there were no conflicts in the northeast, malnutrition would have been reduced.

Table 3: Probit regression for pooled data

Child Malnutrition	**Coefficient (Standard Error)**	**z**	**P-value**	**Marginal Effect**
Resilience Index	-0.117(0.009)	-12.56	0.000	-0.041*
Child's age (months)	0.006(0.001)	10.29	0.000	0.002*
Child's sex (Male)	0.044(0.018)	2.48	0.013	0.015**
Birth order	0.028(0.005)	5.89	0.000	0.010*
Mother's age (years)	-0.007(0.002)	-3.70	0.000	-0.003*
Father's age (years)	-0.003(0.001)	-2.00	0.046	-0.001**
Mother's education				
Primary education	-0.072(0.029)	-2.46	0.014	-0.027**
Secondary education	-0.267(0.033)	-8.05	0.000	-0.097*
Higher education	-0.463(0.052)	-8.84	0.000	-0.164*
Father's education				
Primary education	0.004(0.031)	0.13	0.899	0.001
Secondary education	-0.061(0.030)	-2.04	0.041	-0.022**
Higher education	-0.099(0.041)	-2.44	0.015	-0.035**
Household size	0.024(0.003)	8.92	0.000	0.008*
Father's occupation				
Professional/Technical/ Managerial	0.222(0.085)	2.62	0.009	0.075*
Clerical	0.243(0.101)	2.42	0.016	0.082**
Sales	0.339(0.082)	4.12	0.000	0.116*
Agricultural	0.262(0.081)	3.24	0.001	0.089*
Services	0.259(0.087)	2.99	0.003	0.088*
Manual (skilled and unskilled)	0.286(0.083)	3.46	0.001	0.097*
Geopolitical Zones				
North East	0.195(0.038)	5.12	0.000	0.069*
North West	0.525(0.044)	12.02	0.000	0.189*
South East	-0.037(0.050)	-0.73	0.463	-0.013
South-South	0.037(0.053)	0.71	0.477	0.013
South West	0.200(0.049)	4.07	0.000	0.071*
Constant	-0.588(0.106)	-5.54	0.000	
Number of observation	=	21973		
LR $chi^2(24)$	=	3190.65		

Prob > chi^2	=	0.000
Pseudo R^2	=	0.1060
Log-likelihood	=	-13450.5

Source: Author's Compilation (2023)

Note: *, **, and *** signifies 1%, 5% and 10% significance level, respectively

4.4 Effect of parental resilience on child malnutrition in the Geopolitical zones

The resilience index had a negative relationship with child malnutrition in all GPZ except in the southwest which showed a positive relationship contrary to expectation. The result in the southwest may be attributed to the lower percentage of malnourished children in the zone. The probability of child malnutrition decreases with an increase in the mother's education when compared to those without education in the northeast, northwest and southsouth GPZ except the southeast GPZ which reported an increase in the mother's education to increase the probability of child malnutrition. This may be attributed to the lack of time dedicated to child-rearing. Other socioeconomic characteristics vary in significance across the different Geopolitical Zones with prob>chi^2 of 0.000 in all the models.

Table 4: Probit regression result for Northern Geopolitical zones

	North Central			North East			North West		
Child Malnutrition	**Coef. (S.E)**	**P-value**	**dy/dx**	**Coef. (S.E)**	**P-value**	**dy/dx**	**Coef. (SE)**	**P-value**	**dy/dx**
Resilience Index	-0.174 (0.037)	0.000	-0.059*	-0.163 (0.013)	0.000	-0.058*	-0.067 (0.024)	0.006	-0.023*
Child's age (months)	0.001 (0.002)	0.736	0.000	0.006 (0.001)	0.000	0.002*	0.009 (0.001)	0.000	0.003*
Sex (Male)	0.197 (0.072)	0.006	0.067*	0.076 (0.025)	0.002	0.027*	-0.031 (0.042)	0.458	-0.011
Birth order	0.004 (0.026)	0.873	0.001	0.034 (0.006)	0.000	0.012*	0.006 (0.010)	0.551	0.002
Mother's age (years)	-0.008 (0.010)	0.391	-0.003	-0.010 (0.003)	0.000	-0.004*	0.007 (0.004)	0.097	0.002***
Father's age (years)	0.006 (0.006)	0.315	0.002	0.000 (0.002)	0.831	0.000	-0.007 (0.003)	0.016	-0.003**
Mother's education Primary	0.102 (0.112)	0.364	0.036	-0.029 (0.040)	0.463	-0.011	0.066 (0.074)	0.375	0.023
Secondary	-0.045 (0.117)	0.700	-0.016	-0.197 (0.044)	0.000	-0.072*	-0.457 (0.101)	0.000	-0.171*
Higher	-0.378 (0.199)	0.058	-0.120**	-0.416 (0.070)	0.000	-0.148*	-0.627 (0.164)	0.000	-0.237*

Father's education Primary	0.252 (0.137)	0.066	0.086**	-0.044 (0.042)	0.299	-0.016	-0.170 (0.072)	0.018	-0.058**
Secondary	0.123 (0.119)	0.302	0.041	-0.070 (0.041)	0.082	-0.025***	0.033 (0.071)	0.641	0.012
Higher	0.045 (0.160)	0.780	0.015	-0.036 (0.056)	0.517	-0.013	-0.127 (0.093)	0.174	-0.046
Household size	0.008 (0.012)	0.513	0.003	0.020 (0.004)	0.000	0.007*	0.028 (0.005)	0.000	0.010*
Father's occupation Professional	0.776 (0.427)	0.069	0.217**	0.446 (0.127)	0.000	0.151*	0.362 (0.175)	0.038	0.137**
Clerical	0.762 (0.488)	0.118	0.212	0.317 (0.148)	0.033	0.105**	0.538 (0.212)	0.011	0.199**
Sales	0.847 (0.429)	0.048	0.242**	0.512 (0.123)	0.000	0.174*	0.515 (0.163)	0.002	0.191*
Agricultural	0.675 (0.414)	0.103	0.183	0.374 (0.121)	0.002	0.125*	0.527 (0.162)	0.001	0.195*
Services	0.662 (0.431)	0.125	0.178	0.347 (0.129)	0.007	0.116*	0.579 (0.177)	0.001	0.213*
Manual	0.804 (0.422)	0.057	0.226**	0.406 (0.124)	0.001	0.137*	0.460 (0.172)	0.007	0.172*
Constant	-1.138 (0.495)	0.005		-0.681 (0.14	0.000		-0.657 (0.223)	0.003	

		6)	
LR chi^2	97.82	502.72	260.90
Pseudo R^2	0.055	0.096	0.508
Log-likelihood	-842.13	-7072.22	-2437.3

Table 5: Probit regression for South East and South South

	South East			South South		
Child Malnutrition	**Coef. (S.E)**	**P-value**	**dy/dx**	**Coef. (S.E)**	**P-value**	**dy/dx**
Resilience Index	-0.080	0.015	-0.025**	-0.091	0.009	-0.029*
	(0.033)			(0.035)		
Child's age (months)	-0.006	0.016	-0.002**	0.003	0.307	0.001
	(0.002)			(0.002)		
Sex (Male)	-0.038	0.552	-0.012	0.003	0.966	0.001
	(0.065)			(0.074)		
Birth order	0.025	0.196	0.008	0.056	0.013	0.018**
	(0.020)			(0.023)		
Mother's age (years)	0.000	0.960	0.000			
	(0.008)					
Father's age (years)	-0.021	0.000	-0.007*	-0.015	0.001	-0.005*
	(0.005)			(0.005)		
Mother's education	0.620	0.002	0.168*	-0.061	0.645	-0.021
Primary	(0.200)			(0.132)		
Secondary	0.465	0.026	0.119**	-0.251	0.079	-0.083***
	(0.209)			(0.143)		
Higher	0.504	0.042	0.130**	-0.402	0.061	-0.128***
	(0.248)			(0.215)		
Household size	-0.001	0.917	0.000	0.039	0.026	0.013**
	(0.012)			(0.018)		
Father's occupation	0.133	0.755	0.029	-0.581	0.009	-0.202*
Professional	(0.425)			(0.221)		
Clerical	0.106	0.831	0.023	-0.82	0.009	-0.266*
	(0.499)			(0.314)		
Sales	0.391	0.342	0.098	-0.428	0.059	-0.153**
	(0.411)			(0.226)		
Agricultural	0.817	0.046	0.240**	-0.402	0.048	-0.145**
	(0.410)			(0.204)		
Services	0.323	0.444	0.078	0.097	0.689	0.037
	(0.422)			(0.242)		
Manual	0.429	0.295	0.109	-0.537	0.011	-0.188**
	(0.409)			(0.210)		
Constant	-0.446	0.377		0.252	0.488	
	(0.504)			(0.363)		
LR chi^2		96.89			83.41	
Pseudo R^2		0.046			0.0504	
Log-likelihood		-1017.39			-786.244	

Note: *, **, and *** signifies 1%, 5% and 10% significance level, respectively

	South West		
Child Malnutrition	**Coefficient (S.E)**	**P-value**	**dy/dx**
Resilience Index	-0.067(0.024)	0.024	0.024**
Child's age(months)	0.009(0.001)	0.008	0.002*
Sex (Male)	-0.031(0.042)	0.475	0.015
Birth order	0.006(0.010)	0.369	0.007
Mother's age (years)	0.007(0.004)	0.003	-0.008*
Father's age (years)	0.071(0.031)	0.544	0.001
Mother's education	-0.483(0.114)	0.000	-0.184*
Primary			
Secondary	-0.708(0.120)	0.000	-0.261*
Higher	-0.900(0.174)	0.000	-0.318*
Father's education	-0.297(0.114)	0.009	-0.109*
Primary			
Secondary	-0.327(0.109)	0.003	-0.119*
Higher	-0.640(0.144)	0.000	-0.217*
Household size	0.014(0.017)	0.389	0.005
Constant	0.631(0.248)	0.011	
LR chi^2	126.41		
Pseudo R^2	0.0530		
Log-likelihood	-1129.724		

Table 6: Probit regression for South West

Note: *, **, and *** signifies 1%, 5% and 10% significance level, respectively.

4.4.1 Probability of child malnutrition by Geopolitical Zone

Table 7 shows the probability that a child chosen at random in each of the GPZs will be malnourished. The aggregate value for Nigeria was 0.51. This implies that a little above half of the Nigerian children are likely to be malnourished. Among the six geopolitical zones in Nigeria, the northwest region had the highest probability of having malnourished child (0.68), while the southeast had the lowest probability (0.30). Overall, the northern region had higher probability of selecting a malnourished child; 0.68, 0.51, and 0.37, for northwest, northeast and northcentral, respectively. The southern regions have low probabilities of 0.30, 0.33 and 0.34 for South East, southsouth and southwest, respectively. The negative skewness affirmed that the northern zone

had more malnourished children. The value indicates that there are more northern children with higher probability of being malnourished than the average value. The reverse is the case in the southern zone with positive. This result aligns with studies (John *et al.,* 2024; Akombi-Inyang, 2021) that found that there are numerous early childhood malnutrition problems in Nigeria, especially in the northern states, with significant regional variations.

Table 7: Probability of child malnutrition by GPZ

	Pooled		North Central		North East		North West		South East		South South		South West	
	Freq.	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
0.05 - 0.21	555	5.8	40	8.66	270	5.4	1	0.04	125	25.77	70	17.72	65	10.8
0.22 - 0.37	1,879	19.65	175	37.88	904	18.09	63	2.4	220	45.36	199	50.38	310	51.5
0.38 - 0.54	2,304	24.09	233	50.43	1,359	27.2	172	6.56	139	28.66	101	25.57	150	24.92
0.59 - 0.76	3,688	38.56	14	3.03	2,099	42.01	1,279	48.76	1	0.21	25	6.33	77	12.79
0.72 - 0.88	1,138	11.9	0	0	365	7.3	1,108	42.24	0	0	0	0	0	0
Mean	0.51		0.37		0.51		0.68		0.30		0.33		0.34	
Zonal Mean			**0.52**						**0.32**					
Std.deviation	0.17		0.11		0.16		0.10		0.10		0.12		0.13	
Skewness	-0.38		-0.34		-0.44		-1.65		0.25		0.56		0.44	

4.5 Comparison of parental child resilience among Geopolitical Zones

The nursing mothers in Geopolitical Zones in Nigeria react to shocks differently due to differences in civilisation, exposure and educational level. Table 8 shows that parents in geopolitical zones significantly differ regarding the resilience index ($p<0.01$). Table 7 shows that southwest's parents were the most resilient to child malnutrition. Parents in the northwest were the least resilient to child malnutrition. Studies ((UNICEF, 2019; Belesova *et al.,* 2019; Tette *et al.,* 2015) attributed high parental resilience to employment, reduced/lack of community conflict, parental education, and reduced socio-economic inequalities.

Table 7: ANOVA result

Parameter		Geopolitical Zones	Mean	Standard deviation	P-value	F^{cal}
Parental Index	Resilience	Northcentral	-0.3	1.61	0.000*	369.58
		Northeast	-0.81	1.73		
		Northwest	-1.29	1.40		
		Southeast	0.88	1.31		
		South-South	0.59	1.31		
		Southwest	1.02	1.3		

Note: $*$ represents significance at 1%

4.6 Limitations of the study

The following limitations are identified in the study:

(i) Despite controlling for several socio-demographic and economic factors, the study could not account for unobservable variables such as parental mental health, social support networks, or cultural beliefs, which could influence both resilience and child nutrition outcomes.

(ii) The study utilised the 2018 Nigeria Demographic and Health Survey (DHS), which was not originally designed to measure parental resilience. As a result, key resilience-related variables may have been either absent or inadequately captured, limiting the depth and precision of the constructed resilience index.

(iii) Child malnutrition indicators (e.g., stunting, wasting, underweight) were based on anthropometric measurements taken at one point in time, which may not fully reflect long-term nutritional status or recent changes influenced by parental behaviour or resilience.

4.7 Way forward to the limitations

(i) Future conducts of the Nigeria Demographic and Health Survey (DHS) or similar national datasets should incorporate validated tools to measure parental resilience, such as psychological, emotional, and social resilience scales. This will allow for more accurate and multidimensional assessments.

(ii) Establishing causality between parental resilience and child malnutrition outcomes requires longitudinal or panel data. Future research should prioritise tracking households over time to understand how resilience dynamics influence nutritional trajectories

(iii) To overcome the limitations of secondary data, future research should integrate primary data collection, particularly using mixed methods, to capture context-specific aspects of resilience, including qualitative insights into parental coping strategies, mental health, and community support systems.

(iv) While PCA is valuable for index construction, alternative or complementary methods, such as confirmatory factor analysis or structural equation modelling, could help better capture the complexity and latent structure of resilience in future studies.

4.8 Implications of the study

(i) The findings suggest that parental resilience plays a significant role in influencing child nutrition outcomes. This underscores the need for national nutrition and child health policies to incorporate resilience-building components—such as psychosocial support, livelihood strengthening, and stress management programs for parents, particularly in vulnerable communities.

(ii) The use of a resilience index can help identify households with low resilience and high vulnerability to child malnutrition. This enables better targeting of nutrition-sensitive interventions, ensuring that the most at-risk families are prioritized in both emergency responses and long-term development programs.

(iii) Addressing child malnutrition requires more than just food security and healthcare access. The study supports a holistic, multisectoral intervention approach that includes social protection, and community-based support systems to strengthen families' coping capacities during economic, social, or environmental shocks.

4.9 Conflict of Interest

There is no conflict of interest among the authors

5.0 Conclusions and recommendation

The study highlights the critical role of parental resilience in mitigating child malnutrition in Nigeria. The study revealed that parental resilience negatively influenced child malnutrition (stunted, wasted and underweight). Education and access to basic infrastructures were found to improve parental resilience, which in turn improves the quality of life of the children. Strengthening parental resilience can therefore serve as a protective factor against malnutrition, promoting better health and development in children. The study affirmed that malnutrition was more common in male children. The likelihood of a child being malnourished was higher among illiterate and unemployed mothers. The disparity in child malnutrition (more in the north) and parental resilience (high in the south) by region was affirmed by the study. This was corroborated by a high probability of a child being malnourished in the northern zone. Specifically, the northeast had the highest percentage of malnourished children. The northwest

had the least parental resilience to child malnutrition, while southwest parents were the most resilient. The study showed the importance of parent education for resilience and to reduce child malnutrition. Governments, NGOs, Community Development Association and healthcare providers must work together to create supportive environments where parents can thrive and provide for their children effectively. The need for government to prioritize education in the northern GPZs is recommended. Conducive learning environment should be accompanied by well-trained teachers with training and re-training to enhance their skill are advocated. Non-Governmental Organisations can help parents by encouraging them to engage in adult education as a way to make up for the regular schooling they missed. The need to build adaptive capacity and access to basic services through Community Development Associations and Local Government Authorities will help to raise parental resilience, most especially in the northern geopolitical zones.

Appendices

	Malnourished		Normal		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Child's age (months)						
0-23	2,231	23.33	3,912	31.53	6,531	29.72
24-47	4,832	50.52	5,132	41.36	10,098	45.96
48-59	2,501	26.15	3,365	27.12	5,344	24.32
Child's sex						
Male	4945	51.7	6217	50.1	11,162	50.80
Female	4619	48.3	6192	49.9	10,811	49.20
Child's birth order						
1-5	7,592	79.38	10,747	86.61	18,339	83.46
6-10	1,861	19.46	1,611	12.98	3,472	15.80
11-15	111	1.16	51	0.41	162	0.74
Mother's age (years)						
15-25	1,279	13.37	1,553	12.52	2832	12.89
26-35	4,611	48.21	6,228	50.19	10839	49.33
36-49	3,674	38.41	4,628	37.30	8302	37.78
Father's age (years)						

15-25	110	1.15	163	1.31	273	1.24
26-35	1,792	18.74	2575	20.75	4367	19.87
36-49	4,520	47.26	6720	54.15	11240	51.15
50 and above	3,142	32.85	2951	23.78	6093	27.73
Mother's education						
No formal education	5495	57.46	3559	28.68	9054	41.21
Primary education	1901	19.88	2633	21.22	4534	20.63
Secondary education	1892	19.78	4959	39.96	6851	31.18
Higher education	276	2.89	1258	10.14	1534	6.98
Father's education						
No formal education	4107	42.94	2566	20.68	6673	30.37
Primary education	1774	18.55	2320	18.7	4094	18.63
Secondary education	2783	29.1	5428	43.74	8211	37.37
Higher education	900	9.41	2095	16.88	2995	13.63
Father's occupation						
Unemployed	98	1.02	194	1.56	292	1.33
Professional/ technical/managerial	807	8.44	1,669	13.45	2,476	11.27
Clerical	171	1.79	330	2.66	501	2.28
Sales	1,978	20.68	2,244	18.08	4,222	19.21
Agricultural	4,449	46.52	4,385	35.34	8,834	40.20
Services	596	6.23	908	7.32	1,504	6.84
Manual (skilled and unskilled)	1465	15.32	21679	21.59	4123	18.86

Appendix 1: Child malnutrition status by socioeconomic characteristics

Appendix 2: Distribution of child malnutrition by parents' assets ownership

Parents Household Assets		Malnourished		Normal		Total	Percentage
		Frequency	Percentage	Frequency	Percentage		
Radio	No	4286	44.81	4286	34.54	8572	39.01
	Yes	5278	55.19	8123	65.46	13401	60.99
Television	No	6391	66.82	5393	43.46	11784	53.63
	Yes	3173	33.18	7016	56.54	10189	46.37
Refrigerator	No	8628	90.21	9376	75.56	18004	81.94
	Yes	936	9.79	3033	24.44	3969	18.06
Bicycle	No	7532	78.75	10549	85.01	18081	82.29

	Yes	2032	21.25	1860	14.99	3892	17.71
Motorcycle/ scooter	No	5983	62.56	7588	61.15	13571	61.76
	Yes	3581	37.44	4821	38.85	8402	38.24
Car/truck	No	8944	93.52	10827	87.25	19771	89.98
	Yes	620	6.48	1582	12.75	2202	10.02
Mobile telephone	No	5861	61.28	4479	36.09	10340	47.06
	Yes	3703	38.72	7930	63.91	11633	52.94
House	No	8374	87.56	10107	81.45	18481	84.11
	Yes	1190	12.44	2302	19.55	3492	15.89
Land	No	7990	83.54	9921	79.95	17911	81.51
	Yes	1574	16.46	2488	20.05	4062	18.49

Appendix 1: Distribution of child malnutrition status by the parent's access to basic amenities

Access to basic amenities		**Malnourished**		**Normal**			
		Frequency	**%**	**Frequency**	**%**	**Total**	**%**
Source of drinking water	Unsafe	3570	37.33	3341	26.92	6911	31.45
	Safe	5994	62.67	9068	73.08	15062	68.55
Type of toilet facility	Unimproved	5467	57.16	5714	46.05	11181	50.89
	Improved	4097	42.84	6695	53.95	10792	58.11
Electricity	No	5246	56.73	5243	42.25	10489	47.74
	Yes	4138	43.27	7166	57.75	11484	52..26
Energy (Cooking)	Solid Fuel	8835	92.38	9506	76.61	18341	83.47
	Clean Fuel	729	7.62	2903	23.39	3632	16.53
Use of Internet	No	9212	96.32	10958	88.31	20170	91.80
	Yes	352	3.68	1451	11.69	1803	8.20

Appendix 4: Distribution of child malnutrition status by the parent's adaptive capacity

Adaptive Capacity		Malnourished		Normal		Total	
		Frequency	%	Frequency	%		%
Health insurance	No	9473	99.05	12071	97.28	21544	98.05
	Yes	91	0.95	338	2.72	429	1.95
Account	No	8742	91.41	9461	76.24	18203	82.84
(Financial Institution)	Yes	822	8.59	2948	23.76	3770	17.16
Educated Mother	No	5495	57.46	3559	28.68	9054	41.21
	Yes	4069	42.54	8850	71.32	12919	58.79
Employed Mother	No	430	4.50	600	4.84	1030	30.37
(Wage Earner)	Yes	9134	95.50	11809	95.16	29943	69.63
Educated Father	No	4107	42.94	2566	20.68	6673	4.69
	Yes	5457	57.06	9843	79.32	15300	95.31
Employed Father	No	98	1.02	194	1.56	292	1.33
(Wage Earner)	Yes	9466	98.98	12215	98.44	21681	98.67

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