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# Nutritional Vulnerability Transitions among Rural Households in Nigeria

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***Author's contribution***

*The sole author designed, analysed, interpreted and prepared the manuscript.*

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## ABSTRACT

**Aims:** It has long been considered that specific age/gender groups, such as women and children, are predisposed to nutritional vulnerability. Thus, nutritional vulnerability among agricultural households is neglected and understudied. This study aims at an empirical assessment of nutritional vulnerability dynamics among rural households in Nigeria.
**Study Design:** Secondary data used for this study was waves 2 and 3 of the general household survey panel data. The sampling design consisted of two stages of sampling: the selection of enumeration areas based on probability proportionate to the size of the enumeration areas and the systematic random selection of ten households from each enumeration area. There were 3370 households selected in rural areas and 1630 households selected in urban areas. 2090 rural households with the required information for this study were included in the analysis.
**Methodology:** Descriptive statistics, nutritional vulnerability score, logit regression model, Markov model, and multinomial logit regression models were used to analyse nutritional vulnerability transitions among rural households in Nigeria.
**Results:** Nutritionally vulnerable households in rural Nigeria include those with aged heads, little or no formal education, limited assets, and no access to land or credit. Nutritional vulnerability in rural Nigeria is primarily transient, with around two-fifths of households experiencing transient nutritional vulnerability and nearly one-third experiencing chronic nutritional vulnerability. While the age of the household head, tertiary education, and access to credit all had a substantial impact on transient

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nutritional vulnerability, gender, tertiary education, asset value, and access to credit all had an impact on chronic nutritional vulnerability.
**Conclusion:** Support mechanisms such as initiatives to promote access to healthy food, credit, land, and education are critical. To successfully address the issues affecting the nutrition and health of persons facing vulnerabilities, social welfare programs with interventions based on the characteristics of each vulnerable group and the predisposing factors should be adopted.

*Keywords: Nutritional vulnerability; chronic; transient; rural households; Nigeria.*

## 1. INTRODUCTION

As man's primary source of nutrients, food remains a basic and essential requirement for his survival and well-being. Diet and nutrition are necessary for good immunity and system function from conception to adulthood [1,2]. The nutritional status of all individuals, regardless of age group, is thus an essential component of their mental and physical health and healthy growth [3]. In essence, the nutritional state of an individual is indicative of an individual's vigour and vitality; a state that can translate into enhanced productivity and greater chances of escaping the cycle of poverty. Notwithstanding these perspectives and possibilities regarding nutrition, the world's largest challenge continues to be getting sufficient and nutritious food for all in a sustainable and environmentally responsible manner [4,5].

Individuals are nutritionally susceptible due to malnutrition, a condition in which the body does not obtain the basic nutrients it requires for healthy living [6], and other related hazards. Nutritional vulnerability implies a decreased physiological reserve that impedes recuperation during a severe health concern, and markedly reduced resilience and other susceptible factors resulting from a poor diet [7]. In many developing nations, it has been considered that nutritional vulnerability is greatest among certain age/gender groups, including women and children, the elderly, and pregnant or lactating mothers, among others [8]. As a result, the effects of malnutrition on rural households are understudied and frequently overlooked, as it is commonly believed that the majority of rural households are farmers and therefore cannot be malnourished. Rural households not only experience malnutrition at a particular point in time, but they also move in and out of the malnourished state over time, depending on the severity of the shocks they face and their ability to respond to these shocks that impact their livelihood. However, the focus of relief interventions is primarily on other population groups, while the nutritional status and nutritional vulnerabilities of rural households are neglected.

Since the majority of people in the country live in agricultural households and stunted growth, inadequate nutrition, and wasting remain especially prevalent among the rural poor, the incidence of malnutrition and poor health in rural areas of the country remains high [9]. These households are typically more disadvantaged with respect to food insecurity, inadequate nutrition, and poor health. Thus, in order to improve the nutritional well-being of these households and promote national economic growth, it is crucial to examine food and health issues in rural communities. Further, given that the rural southwestern region of Nigeria is a key small agricultural hub, the food dietary habits, nourishment, and general well-being of rural households should be of the utmost importance to policymakers. This is because the developmental, financial, social, and health-related effects of the global malnutrition burden or other forms of nutritional vulnerabilities are severe and long-lasting for individuals and their families, communities, and countries [10]. In rural farming households in Nigeria, food intake has remained consistently low, while malnutrition and ill health have steadily worsened over time. Initial efforts to combat this problem have been unsuccessful [11].

In fact, Nigeria is currently, the fifth country in the world experiencing a food crisis, following Ethiopia and the Democratic Republic of the Congo. Specifically, over a hundred million individuals are severely or moderately food insecure, and one-third of households are unable to purchase a nutrient-dense diet. Despite becoming a lower-middle-income country in 2014, Nigeria's enormous growth possibilities have not been fully explored. As a result of organised violence, periodic extreme climatic events, and extensive exposure to the consequences of changing climates, Nigeria's most at-risk populations remain plagued by

extremely high rates of hunger and malnutrition [12]. In addition to identifying nutritionally vulnerable individuals, this effort will investigate nutritional vulnerability transitions among rural households in Nigeria.

To my knowledge, few studies have studied the food intake, health, and nutritional status of rural households, and even fewer have sought to assess nutritional vulnerability [13-16]. These previous studies did not examine nutritional vulnerability transitions or the factors that influence whether a household will move out of or remain in nutritional vulnerability from one period to the next. To address this information gap, this study provides empirical evidence on nutritional vulnerability and related transitions among rural households in Nigeria. In addition, this study will contribute to the existing knowledge on nutrition among rural households as well as the scant literature on nutritional vulnerability transitions in rural households. In particular, the findings of this study will present empirical proof of the correlates of nutritional vulnerability among households in rural Nigeria and provide reliable qualitative findings that will assist policymakers in formulating strategies that will improve the food intake, nutrition, and health of rural households in Nigeria.

## 2. MATERIALS AND METHODS

### 2.1 Scope of Study

This study focuses on Nigeria. Nigeria includes 36 states including Abuja, the Federal Capital Territory. It contains 774 Local Government Areas (LGAs) and over two hundred million inhabitants [17]. Nigeria is surrounded by Cameroon to the east, Chad to the northeast, Niger to the north, Benin to the west, and the Atlantic Ocean to the south. Nigeria is located between 4º 1 North Latitude and 2º 2 and 14º 3 East Longitude. It is 923,768 square kilometres in size. Nigeria has a tropical climate that is occasionally vulnerable to fluctuation due to rainfall patterns. The average annual temperature is between 25 and 28 degrees Celsius. Rice, millet, groundnut, yam, cassava, watermelon, plantain, and banana are among the major crops.

### 2.2 Types and Sources of Data

As part of the Integrated Surveys on Agriculture (ISA) program, the National Bureau of Statistics (NBS) and the World Bank Living Standard Measurement Survey (LSMS) team collected panel data from the General Household Survey (GHS) that served as the secondary data source for this study. The panel data is divided into Waves l, 2 and 3. Wave 1 of the GHS-Panel data collection took place in 2010-2011, Wave 2 in two trips (post-planting in September 2012 and post-harvest in February-April 2013), and Wave 3 in 2015-2016. For this investigation, the GHS-Panel Wave 2 and 3 were utilized.

### 2.3 Sampling Procedure and Sample Size

The sampling design consisted of two stages of sampling. In the first stage, Enumeration Areas (EAs) were selected using a probability-to-size (PPS) ratio calculated from the total number of EAs and households in all EAs across each state and the Federal Capital Territory. In total, 500 EAs were chosen using this process. In the second stage, ten households were systematically selected at random from each EA, for an overall total of 5000 households. There were 3370 households selected in rural areas and 1630 households selected in urban areas. However, only 2090 rural households that had all the necessary information pertinent to this study were included in the analysis and served as the study's sample size.

### 2.4 Method of Data Analysis

Descriptive statistics, a nutritional vulnerability score, a Markov model, and a multinomial logistic regression model were employed as analytical tools in this study. Using descriptive statistics like mean, frequency distribution, and percentages, rural households in Nigeria were described in terms of their socio-economic features. The nutritional vulnerability of rural households in Nigeria was examined using a vulnerability score obtained from a modified version of the Nutrition Screening Initiative Checklist, which was also adopted by Olayiwola et al. [13]. The checklist was adjusted to accommodate Nigeria's conditions, adding other criteria such as the ability to access fuel, water, and power or not as this they may induce people to opt for dietary habits that are unhealthy. Each of the 21 items evaluated was assigned one point. Hence, a household might receive a maximum of 21 points if all items on the checklist are scored. The mean vulnerability score was utilised as the score line, with non-nutritional vulnerable households being those with scores below the mean and nutritional vulnerable households being those with scores above the mean. The Markov model was applied

to examine nutritional vulnerability transitions. In other words, the nutritional vulnerability matrix and the simple-first order Markov model were applied to trace the nutritional vulnerability transitions of households.

Where:

$f_{11}$ = Non-nutritionally vulnerable in the second wave and non-nutritionally vulnerable in the third wave
$f_{12}$= Non-nutritionally vulnerable in wave 2 and nutritionally vulnerable in wave 3
$f_{21}$= Nutritionally vulnerable in wave 2 and non-nutritionally vulnerable in wave 3
$f_{22}$ = Nutritionally vulnerable in wave 2 and nutritionally vulnerable in wave 3
$f_1$ = Total number of non-nutritionally vulnerable households in the two waves
$f_2$ = Total number of nutritionally vulnerable households in the two waves
$F$ = Total number of households

Households that were not nutritionally vulnerable in wave 2 but were in wave 3 and vice versa were said to be transiently nutritionally vulnerable, while households that were nutritionally vulnerable in both waves were said to be chronically nutritionally vulnerable.

The determinants of nutritional vulnerability transitions were identified employing the multinomial regression model as follows:

Considering the random variable $Yi$, which in this study represents the nutritional vulnerability transitions categories and has the values "Always non-nutritionally vulnerable," "Entering nutritional vulnerability," "Exiting nutritional vulnerability," and "chronically nutritional vulnerable" which are indexed 0,1,2,3. $Yi$ can take one of several discrete values indexed 1, 2, 3,....., $j$.

With respect to the model, each individual will fall into one of the categories with a certain probability.

$$\text{Let, } \pi_{ij} = \Pr(Y_i = j) \quad (1)$$

This denotes the probability that the $ith$ response falls in the $jth$ category. In other words, $\pi_{ij}$ is the probability that the $ith$ household is entering nutritional vulnerability.

The most straightforward method for analysing multinomial data involves designating one of the response categories as the baseline or reference cell, computing log-odds for each of the remaining categories in relation to the baseline, and subsequently modeling the log-odds as a linear function of the predictors. Predictably, the always non-nutritional vulnerable was made the reference group (as a baseline), and the probabilities that a household *'i'* falls in the category $j$ as opposed to the baseline $\pi_{il}/\pi_{lj}$ estimated.

The preferred method of relating $\pi_l$ to covariates in this study is through a set of $j*-1$ baseline-category logit, given that the household categories 0,1,2,3……, $j$ are unordered. The model is based on $j*$ as the reference category as follows:

$$\log\left(\frac{\pi ij}{\pi ij}\right) = x_i^T \beta_j j \neq j^* \quad (2)$$

The baseline–category probability ($Yi = j*(0)$) can be written as

$$\pi_{i0} = \frac{1}{1+\sum_{j=1}\exp(x_i^T \beta_j)} \quad (3)$$

The probability of $Yi = j$ in relation to the baseline category $Y = j*(0)$ is given by the odds ratio.

$$\pi_{ij} = \frac{\exp(x_i^T \beta_j)}{1+\sum_{j=1}^{3}\exp(x_i^T \beta_j)}, j = 1,2,3 \quad (4)$$

**Table 1. First-order Markov model of nutritional vulnerability transitions**

| **Wave 2** | **Wave 3** | | |
|---|---|---|---|
| | **Non-nutritional vulnerable** | **Nutritional vulnerable** | **Total** |
| Non-nutritional vulnerable | $f_{11}$ | $f_{12}$ | $f_1$ |
| Nutritional vulnerable | $f_{21}$ | $f_{22}$ | $f_2$ |
| **Total** | $\boldsymbol{f_1}$ | $\boldsymbol{f_2}$ | $\boldsymbol{F}$ |

Where $\pi_{ij}$ $(j = 0,1,2,3)$ = the probability associated with the nutritional vulnerability transitions categories of a household $i\ with\ j = 0$ if the household is always non-nutritional vulnerable; $j = 1$ if the household is entering nutritional vulnerability; $j = 2$ if the household is exiting nutritional vulnerability; and $j = 3$ if the household is chronically nutritional vulnerable. According to Greene et al. [18], the natural logarithms of the odd ratio of equations (3) and (4) give the estimated equation as:

$$\ln \frac{\pi_{ij}}{\pi_{io}} \beta_j x_i \quad (5)$$

This indicates the comparative likelihoods of groups 1, 2, and 3 relative to the probability of the reference group. Consequently, the coefficient estimate for each option reflects the impact of $Xi$ variables on the probability of households selecting the reference group. The explanatory variables, denoted as $Xi$, are held constant across the various alternatives. The estimation of parameters quantifies the effect of a one-unit increment in the explanatory variable of interest on the logarithmic odds ratio of the specific state compared to the reference category. The explicit expression of the multinomial logit regression model is as follows:

$$Y_0 = \alpha_0 + \beta_{10}X_1 + \beta_{20}X_2 \ldots\ldots\ldots \beta_n X_n + \varepsilon i \quad (6)$$

$$Y_1 = \alpha_1 + \beta_{11}X_1 + \beta_{21}X_2 \ldots\ldots\ldots \beta_n X_n + \varepsilon i \quad (7)$$

$$Y_2 = \alpha_2 + \beta_{12}X_1 + \beta_{22}X_2 \ldots\ldots\ldots \beta_n X_n + \varepsilon i \quad (8)$$

$$Y_3 = \alpha_3 + \beta_{13}X_1 + \beta_{23}X_2 \ldots\ldots\ldots \beta_n X_n + \varepsilon i \quad (9)$$

$Yi$ denotes four non-sequential groupings of nutritional vulnerability transitions:

$Y_0$ = Always non-nutritionally vulnerable in both waves (which is the base category)
$Y_1$ = those who are non-nutritionally vulnerable in the second, but nutritionally vulnerable in the third wave (i.e transitorily nutritionally vulnerable)
$Y_2$ = those who are nutritionally vulnerable in the second wave, but non-nutritionally vulnerable in the third wave (i.e transitorily nutritionally vulnerable)
$Y_3$= those who are nutritionally vulnerable in both waves (chronically nutritionally vulnerable)

$X_1 \ldots\ldots X_n$ represent vector of the explanatory variables where $n = 1 \ldots\ldots 13$

$\beta_1 \ldots\ldots \beta_{13}$ represent the parameter coefficients.
$\varepsilon i$ = represents the independently distributed error terms

$\alpha_0 - \alpha_3$ shows the intercept or constant terms.

The independent variables in the model are:

$X_1$= Gender (1 male; 0 if otherwise)
$X_2$= Household size (number)
$X_3$= Age of household head (years)
$X_4$= Marital status of respondent (1 if married; 0 if otherwise),
$X_5$= Household head has primary education (1 if yes; 0 if otherwise),
$X_6$= Household head has secondary education (1 if yes; 0 if otherwise),
$X_7$= Household head has tertiary education (1 if yes; 0 if otherwise),
$X_8$= Household head primary occupation (1 if farming; 0 if otherwise)
$X_9$= Access to land (1 if yes; 0 if otherwise),
$X_{10}$= Value of assets (Naira)
$X_{11}$= Access to remittances (1 if yes; 0 if otherwise),
$X_{12}$= Access to credit (1 if yes; 0 if otherwise),
$X_{13}$= Expenditure on food items (Naira)

## 3. RESULTS AND DISCUSSION

Table 2 shows some of the respondents' socioeconomic characteristics. In the study area, male-headed households predominated. Respondents' average age was 53.5 years, and almost all had some type of formal education, with most having elementary education. This might be because most people in rural areas do not place a high value on furthering their education above high school. This could be since it is not a requirement for survival. Additionally, over 80% of the household heads were married, with approximately 7 members per household on average.

### 3.1 Nutritional Vulnerability Status of Respondents

Households were categorised as nutritionally vulnerable or not nutritionally vulnerable based on their nutritional vulnerability score. The nutritional vulnerability of households was calculated using the mean total household vulnerability score. For waves two and three of the GHS-Panel data, the mean household vulnerability score was estimated to be 9.8 and 9.3 respectively, indicating that a household with

a vulnerability score at or above these mean scores was classified as nutritionally vulnerable, while a household with a vulnerability score below these mean scores was classified as non-nutritionally vulnerable, as shown in Table 3. The results of this empirical study reveal that nutritional vulnerability is not a static phenomenon. Rather, households enter and exit the phenomena from period to period, although the status of some households does not change. 49.7% of respondents in the second wave were not nutritionally vulnerable. However, 56.5% of respondents in the third wave fell into this category. Hence, several households that were nutritionally vulnerable during the second wave were no longer vulnerable during the third wave. In addition, nutritional vulnerability fell from 50.3% to 43.9% during the second and third waves.

**Table 2. Selected socioeconomic characteristics of respondents**

| Variables | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 1883 | 90.1 |
| Female | 207 | 9.9 |
| **Age(in years)** | | |
| <40 | 346 | 16.6 |
| 40-69 | 1445 | 69.1 |
| ≥ 70 | 299 | 14.3 |
| Mean: 53.5 | | |
| S.D: 13.9 | | |
| **Household Size** | | |
| 1-4 | 338 | 16.1 |
| 5-9 | 1189 | 73.1 |
| ≥10 | 563 | 26.9 |
| Mean:7 | | |
| S.D:3 | | |
| **Marital Status** | | |
| Married | 1806 | 86.4 |
| Separated | 39 | 1.8 |
| Widowed | 227 | 10.9 |
| Single | 18 | 0.9 |
| **Education Status** | | |
| No education | 329 | 15.7 |
| Primary education | 1357 | 64.9 |
| Secondary education | 247 | 11.9 |
| Tertiary education | 157 | 7.5 |
| **Total** | **2090** | **100.0** |

**Table 3. Nutritional vulnerability status of respondents**

| Nutritional-Vulnerability Status | Frequency Wave 2 | Percentage | Frequency Wave 3 | Percentage (%) |
|---|---|---|---|---|
| Non- Nutritionally Vulnerable | 1038 | 49.7 | 1172 | 56.1 |
| Nutritionally Vulnerable | 1052 | 50.3 | 918 | 43.9 |
| **Total** | **2090** | **100.0** | **2090** | **100.0** |

### 3.2 Nutritional Vulnerability Profile of Rural Households in Nigeria

In Table 4, the nutritional vulnerability status of households in wave 3 (representing more recent data) was disaggregated by socioeconomic factors including age, gender, marital status, occupation, and education. In terms of distribution by age, nutritional vulnerability was lowest for households with household heads under the age of 40, and highest for households with household heads between the ages of 40 and 69. This is contrary to a priori expectations, given that the respondents in this age category are in their productive years, and it highlights the initial discussion in this study of the assumption that, in the majority of developing nations, nutritional vulnerability is inherently greatest among certain age/gender categories of households. The distribution by gender revealed that households headed by men were more nutritionally insecure than those headed by women. This is expected given that females are tasked with preparing nutritious and safe meals for the family. This finding, however, contradicts the results of Omuemu et al. [19]. According to the household size profile, households with between 5 and 9 and greater than 10 individuals were identified to be more nutritionally vulnerable than those with less than 5 members. This may be since the larger the household, the greater the emphasis on quantity rather than nutrient-dense quality meals, making them nutritionally vulnerable.

According to the result, married heads of households were the most nutritionally vulnerable, whereas single household heads were the least nutritionally vulnerable. The analysis of the educational status profile indicated that individuals who are household heads and have completed primary education were most nutritionally vulnerable, followed by those without formal education. This supports the findings of Dominguez-Salas et al. [20]. In which a positive effect of level of education on nutritional status was found and may not be unrelated to the fact that formal education of the household head affects lifestyles and health-related behaviour, which enhances knowledge and perception regarding diet, health, and varied dietary needs. In addition, occupational status revealed that agricultural households were more nutritionally vulnerable than non-agricultural households. In fact, greater than four-fifths of agricultural households were nutritionally vulnerable. The cause can be linked to the fact that their food and income sources are limited, they are exposed to the vagaries of the weather, and they confront profound challenges such as inadequate road infrastructure, storage facilities, and agricultural inputs. All of these factors affect the production and sale of agricultural products, which ultimately reduces the income of farming households and, as a result, their welfare and increases their likelihood of being nutritionally vulnerable. This finding disproves the premise that since the majority of rural households are engaged in agriculture, they are unlikely to be vulnerable to food insecurity. The nutritional vulnerability of farming households is thus an area for further research.

### 3.3 Nutritional Vulnerability Transitions among Rural Households

Rural households experience nutritional vulnerability from period to period. While some households move out of an episode some households move in while there is no change of status for some households. However, various factors influence these movements.

The nutritional vulnerability matrix of rural households is presented in Table 5. While more than three-fifths (68.5%) of those who were non-nutritionally vulnerable in the second wave remained non-nutritionally vulnerable in the third wave (always non-nutritionally vulnerable), 31.5% of those who were non-nutritionally vulnerable in the second wave became nutritionally vulnerable in the third wave (entered nutritional vulnerability).

In addition, while more than two-fifths (43.8%) of those who were nutritionally vulnerable in the second wave transitioned into the non-nutritionally vulnerable group (exited nutritional vulnerability), more than half (56.2%) of those who were nutritionally vulnerable in the third wave remained nutritionally vulnerable, i.e., they were chronically nutritionally vulnerable. In sum, according to Table 6, 28.3% of households were chronically nutritionally vulnerable in both waves, 34.0% were not nutritionally vulnerable in both waves, and 37.7% moved into and out of nutritional vulnerability (transiently nutritionally vulnerable). Consequently, nutritional vulnerability is more transient than chronic among rural households in Nigeria.

**Table 4. Nutritional vulnerability profile of respondents**

| | Non nutritionally vulnerable | | Nutritionally vulnerable | |
|---|---|---|---|---|
| | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| **Age** | | | | |
| <40 | 220 | 18.8 | 126 | 13.7 |
| 40-69 | 840 | 71.7 | 605 | 65.9 |
| ≥ 70 | 112 | 9.5 | 187 | 20.4 |
| **Gender** | | | | |
| Female | 78 | 6.7 | 129 | 14.1 |
| Male | 1094 | 93.3 | 789 | 85.9 |
| **Household Size** | | | | |
| <5 | 161 | 13.7 | 177 | 19.3 |
| 5-9 | 674 | 57.5 | 515 | 56.1 |
| ≥10 | 337 | 28.8 | 226 | 24.6 |
| **Marital Status** | | | | |
| Married | 1055 | 90.0 | 751 | 81.8 |
| Separated | 21 | 1.8 | 18 | 2.0 |
| Widowed | 83 | 7.1 | 144 | 15.7 |
| Single | 13 | 1.1 | 5 | 0.5 |
| **Education** | | | | |
| No education | 173 | 14.8 | 156 | 17.0 |
| Primary | 704 | 60.1 | 653 | 71.1 |
| Secondary | 168 | 14.3 | 79 | 8.6 |
| Tertiary | 127 | 10.8 | 30 | 3.3 |
| **Occupation** | | | | |
| Non Farming | 228 | 19.5 | 120 | 13.1 |
| Farming | 944 | 80.5 | 798 | 86.9 |
| Total | 1172 | 100.0 | 918 | 100.0 |

**Table 5. Nutritional vulnerability transition matrix**

| | **Wave 3** | | **Total** |
|---|---|---|---|
| **Wave 2** | **Non-nutritionally vulnerable** | **Nutritionally vulnerable** | |
| Non-nutritionally vulnerable | 711 (68.5) | 327(31.5) | 1038 |
| nutritionally vulnerable | 461(43.8) | 591(56.2) | 1052 |
| **Total** | **1172** | **918** | **2090** |

*Note: figures in parenthesis are percentages*

**Table 6. Nutritional vulnerability status of rural households**

| **Nutritional vulnerability status** | **Number of households** | **Percentage (%)** |
|---|---|---|
| Always non-nutritionally vulnerable | 711 | 34.0 |
| Transitory nutritionally vulnerable | 788 | 37.7 |
| Always nutritionally vulnerable (chronic) | 591 | 28.3 |
| **Total** | **2090** | **100.0** |

### 3.4 Factors Influencing Nutritional Vulnerability Transitions

Table 7 displays the findings of the multinomial logit regression model analysis conducted to determine the factors influencing nutritional vulnerability transitions in rural Nigeria. The odds ratio of all other response categories compared with the base category was utilised to interpret the drivers of chronic and transient nutritional vulnerability. The base category in this instance is always non-nutritionally vulnerable. The result

of the analysis additionally displays the relative risk ratios (RRR) linked with the diverse explanatory variables. The log-likelihood of -2635.1604, and chi-square value of 362.70 in Table 7 show that the regression is significant at 1% and the model fits the data.

### 3.4.1 Determinants of transient nutritional vulnerability (entering nutritional vulnerability)

Table 7 reveals that the age of the household head, tertiary education, expenditure on food items, the value of assets, access to land, access to credit, and age squared of the household head are the most significant factors in determining the likelihood of rural Nigerian households falling into the nutritional vulnerability group. Age increased the likelihood of households experiencing nutritional vulnerability, whereas factors such as tertiary education, food expenditure, asset value, access to land, and age squared reduced this likelihood. Regarding age, the positive and significant effect shows that older household heads have a greater likelihood of experiencing nutritional vulnerability. In particular, a relative risk ratio of 1.9 indicates that older heads of households are 1.9 times more likely to slip into nutritional vulnerability. This is consistent with a priori expectations and the findings of Amao et al. [21]. On the other hand, tertiary education of household heads had a negative impact, indicating that tertiary education decreased the likelihood of falling into nutritional vulnerability. The relative risk ratio of 0.48 indicates that tertiary-educated household heads are 0.52 times less likely to slip into the nutritional vulnerability class. Through meaningful employment and the acquisition of information, education can facilitate a household's shift from a nutritionally vulnerable to a non-nutritionally vulnerable status. This discovery is consistent with the findings of Adepoju et al. [22]. In addition, the negative effect of expenditure on food items on the likelihood of nutritional vulnerability suggests that households that spend more on food are 0.9% less likely to slip into nutritional vulnerability. Increasing household spending on healthy, nutrient-dense foods improves the household's health and reduces the likelihood of nutritional vulnerability. Similarly, the negative significance of the value of assets obtained by households suggests that a higher value of assets acquired by households reduces the likelihood of nutritional vulnerability. In other words, households whose asset value improved were 0.9 times less likely to slip into nutritional vulnerability. When households put their assets to productive use, they become wealthier and are able to meet their unmet needs. Also, the negative and statistically significant coefficient of access to land suggests that having access to land reduces the likelihood of a household falling into nutritional vulnerability. When households have access to agricultural land, they are able to engage in farming, which provides an extra source of income and if the land is owned, it can be sold to satisfy food requirements during a food shortage.

### 3.4.2 Determinants of transient nutritional vulnerability (exiting nutritional vulnerability)

According to Table 7, tertiary education, household food expenditure, access to credit, and age squared significantly and positively influenced the likelihood of households exiting nutritional vulnerability. The positive and statistically significant coefficient of tertiary education suggested that postsecondary education enhanced the likelihood of escaping nutritional vulnerability. In particular, household heads with tertiary education were 1.6 times more likely to exit nutritional vulnerability. Education provides access to nutritional information and other livelihood opportunities.

In addition, the positive food expenditure variable shows that an increase in the amount a household spends on food products increases the likelihood that the household will exit nutritional vulnerability. Increased food expenditure promotes dietary diversification and helps households to make healthy food selections, hence increasing the likelihood of a household escaping nutritional vulnerability. In addition, the beneficial effect of access to credit on nutritional vulnerability suggests that a household with access to credit has a greater chance of escaping nutritional vulnerability 1.3 times when compared to the base category. This is because loanable funds can be utilised to enhance output through the acquisition and usage of contemporary, upgraded inputs, as well as to meet households' urgent food requirements; as a result, such households are likely to exit nutritional vulnerability. Likewise, there is a positive association between the probability of exiting nutritional vulnerability and age squared, with a negative coefficient of age, indicating the life-cycle effect. This suggests that the likelihood of escaping nutritional

**Table 7. Determinants of nutritional vulnerability transitions**

| **Transitions** | **Entering Nutritional Vulnerability** | | | **Exiting Nutritional Vulnerability** | | | **Always Nutritionally Vulnerable** | | |
|---|---|---|---|---|---|---|---|---|---|
| Variables | RRR | Coeff. | z-value | RRR | coeff | z-value | RRR | coeff | z-value |
| Age | 1.933 | 0.069 | 1.95* | 0.962 | -0.0389 | -1.18 | 0.950 | -0.052 | -1.60 |
| Household size | 0.995 | -0.004 | -0.20 | 1.012 | 0.116 | 0.59 | 1.022 | 0.022 | 1.14 |
| Gender | 1.620 | 0.483 | 1.18 | 0.660 | -0.416 | -1.13 | 0.328 | -1.11 | -3.28*** |
| Marital status | 0.664 | -0.410 | -1.30 | 1.018 | 0.018 | 0.06 | 1.006 | 0.006 | 0.02 |
| Primary | 1.041 | 0.405 | 0.21 | 0.915 | -0.088 | -0.51 | 0.943 | -0.059 | -0.36 |
| Secondary | 0.663 | -0.411 | -1.42 | 1.208 | 0.189 | 0.83 | 0.883 | -0.124 | -0.53 |
| Tertiary | 0.486 | -0.721 | -1.85* | 1.608 | 0.497 | 1.76* | 0.419 | -0.869 | -2.73*** |
| Occupational status | 1.100 | 0.095 | 0.42 | 1.001 | 0.002 | 0.01 | 0.867 | -0.143 | -0.82 |
| Food expenditure | 0.100 | -0.000 | -4.75*** | 1.100 | 0.000 | 2.14** | 0.100 | -0.000 | -4.80*** |
| Asset value | 0.100 | -5.44e-06 | -3.59*** | 0.100 | -2.52e-07 | -0.69 | 0.100 | -2.58e-06 | -3.53*** |
| Remittances | 0.465 | -0.766 | -1.19 | 1.654 | 0.503 | 1.49 | 1.185 | 0.170 | 0.46 |
| Access to land | 0.643 | -0.496 | -2.20** | 1.308 | 0.269 | 1.47 | 0.370 | -0.315 | -1.61 |
| Access to credit | 1.458 | 0.377 | 1.46 | 1.333 | 0.288 | 1.79* | 0.873 | -0.628 | -4.06*** |
| Age squared | 0.011 | -0.000 | -2.25** | 1.001 | 0.001 | 1.72* | 1.001 | 0.001 | 2.80*** |
| **Number of obs = 2090** | | | **LR chi$^2$ =362.70** | | **Prob>chi$^2$=0.0000** | | | **Log likelihood= -2635.1604** | |

****significant at 1%, **significant at 5%, *significant at 10%*

vulnerability diminishes over time and then increases with age. In comparison to their younger counterparts, older household heads are 1.0 times more likely to escape nutritional vulnerability.

#### 3.4.3 Determinants of chronic nutritional vulnerability (always nutritionally vulnerable)

According to Table 7, the variables that influence one's likelihood of experiencing chronic nutritional vulnerability include gender, level of tertiary education, the value of assets, credit access, the amount spent on food, and age squared. There is a link between the gender of the household head and a higher likelihood of a household being nutritionally vulnerable on a long-term basis. This indicates that households in which females are the primary breadwinner are 0.68 times more likely to always be at risk of being chronically nutritionally vulnerable. This could be due to the fact that the income generation for a household headed by a female is typically poor, which is usually a consequence of the woman being widowed. This, in turn, could mean that there is not enough food available when it is needed, as well as that there are fewer options available for meals. The vast majority of women are not aware of healthy diets, do not have adequate knowledge of food types and sources of nutrients, and very few women consume a diet that is considered to be balanced [23]. Household heads having tertiary education were associated with a reduced likelihood of the household being chronically nutritionally vulnerable. It is approximately 0.58 times less likely for household heads with tertiary education to be chronically nutritionally vulnerable. With education, individuals have access to essential information about nutrition as well as alternative sources of revenue generation, which has the potential to ensure that households do not continue to be nutritionally vulnerable over time. This result again lends credence to the observations made by Amao et al. [21]. In a similar vein, the fact that households who spend more money on food are less likely to be in a state of chronic nutritional vulnerability is demonstrated by the negative effect of household food expenditure on being chronically nutritionally vulnerable. An increase in spending on food items enables dietary diversity, which in turn leads to a healthy lifestyle and reduces the likelihood of chronic nutritional vulnerability. In addition, the negative coefficient of asset value implies a lower likelihood that a household will be chronically nutritionally vulnerable. This finding is in line with a priori expectation, as assets can be easily disposed of and the proceeds used to meet dietary needs. Similarly, households that have access to credit have a 0.13 times lower likelihood of always being nutritionally vulnerable.

## 4. CONCLUSION

The study indicates that households in rural Nigeria experience nutritional vulnerability and that while some households remain nutritionally vulnerable from one period to another, there are indeed movements into and out of nutritional vulnerability among households in rural Nigeria. Household head age, tertiary education attainment, the value of assets owned, and access to land and credit are the primary factors that determine whether or not a household is vulnerable to nutritional deprivation. On the other hand, the primary factors that explain chronic nutritional vulnerability among rural households in Nigeria are access to credit, the value of assets owned, the amount spent on food, and tertiary education. Therefore, it is absolutely necessary for those who are nutritionally vulnerable to have access to support mechanisms such as programs to increase access to nutritious food, credit, and land, as well as expanded education on nutrition. In addition, social welfare programs should be implemented in which interventions are based on the unique characteristics of each vulnerable group and the predisposing factors to effectively address the issues that are impacting the nutrition and health of those who are experiencing vulnerabilities.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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