

BMJ Open Household living conditions and food insecurity in Nigeria: a longitudinal study during COVID-19 pandemic

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ABSTRACT

Objective This study set out to investigate the risk of household food insecurity in Nigeria during the novel COVID-19 pandemic using a harmonised dataset of Nigeria's prepandemic face-to-face survey and two waves of the COVID-19 National Longitudinal Phone Survey (NLPS).

Setting Nigeria.

Participants A representative sample of 1674 households is used in the analysis.

Design A longitudinal study.

Results Our longitudinal study reveals a significant increase in the prevalence of food insecurity in Nigeria during the COVID-19 crisis. For a sample of 1674 households used in the analysis, nearly 32% were moderately food insecure in the baseline survey (ie, the prepandemic period), compared with 74% and 72% that faced the same degree of food insecurity in the two waves of the COVID-19 phone survey. In like manner, not up to 4% of the households faced severe food insecurity in the prepandemic period, compared with 43% and 22% that experienced the same level of food insecurity during the period of the pandemic. Based on the available information in the dataset, we construct a composite non-monetary measure (or index) of household well-being and employ the binary logistic model to investigate the objects under study. The empirical results show that the well-being index has a strong negative association with household food insecurity. Further investigation reveals that the risk of being food insecure increases for households in relatively poor living conditions compared with those in the middle category and conversely declines for households in much better living conditions.

Conclusion This study informs an understanding of the prevalence and risk of household food insecurity in Nigeria during the novel COVID-19 pandemic and provides insights that can guide policy actions in responding to the current wave of food crises in Nigeria.

INTRODUCTION

Undoubtedly, food insecurity has turned out to be the most discussed global issue in recent times, following the recent global crises caused by the persistent COVID-19 pandemic and the ongoing war in Ukraine. The economic downturn caused by the pandemic resulted in job losses and reduced

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ We use a longitudinal dataset of Nigerian households collected during the COVID-19 pandemic to study the association between household living conditions and food security in Nigeria.
- ⇒ We employ measures of household food insecurity provided in the dataset, which were computed base on the Food Insecurity Experience Scale methodology.
- ⇒ Our investigation informs an understanding of the risk of food insecurity in Nigeria in the period before and during the COVID-19 pandemic.
- ⇒ Our approach to the measurement of household well-being/living conditions in the study is driven by data availability and is less rigorous for a multidimensional measure of well-being.
- ⇒ The analysis does not account for selection bias; therefore, we do not disavow the possibility of endogeneity in the analytical results, nor do the findings infer causality.

incomes for many people, making it more difficult for them to earn a living. The hard-earned reduction in global poverty was lost because of the pandemic, as more people moved into extreme poverty and were unable to meet basic needs.¹ The confounding effect of the pandemic was more severe in developing countries such as Nigeria, where as many as 4 in 10 persons were already living below US\$1.90 a day prior to the pandemic.² The situation was worsened by the effects of the pandemic, as many Nigerians, estimated at around 86 million of the population, lost their livelihoods during the COVID-19 crisis.³ The World Bank's poverty assessment report asserts that 3.8 million Nigerians moved into extreme poverty in 2020 as a result of the pandemic and projects an additional 5.1 million to transit into poverty by the end of 2022.²

In addition, the lockdowns and other measures implemented to control the spread of the virus disrupted the global food supply

chains and agriculture, leading to food shortages and price increases in some regions. The already-existing food insecurity in many parts of the world, particularly in developing countries, where people were already struggling to access sufficient food, was worsened by the pandemic. Many people in these countries rely on informal work, such as farming and street vending, to survive, and the lockdowns and economic downturn caused by the pandemic have made it difficult for them to earn a living, which has led to an increase in hunger and malnutrition in many parts of the world. Preliminary evidence revealed that the number of food-insecure populations was escalating in many parts of the world during the COVID-19 pandemic and the associated mobility lockdowns.⁴⁻⁶ In Nigeria, for instance, household food insecurity was predicted to increase by 6–15 percentage points with additional cases of COVID-19 or mobility lockdowns.⁴ Similar empirical evidence exists for other developing countries such as Ghana, where a SD increase in an instrumented COVID-19 measure leads to a 0.232 SD increase in poverty and a 0.289 SD increase in food insecurity.⁵

In the same vein, global reports on food crises confirmed the rising profile of food-insecure populations around the world.⁷⁻¹⁰ According to the 2022 Global Report on Food Crises, the number of acutely food insecure populations at the end of 2020 was around 151 million against 135 million in 2019.¹⁰ In 2021, close to 193 million people in 53 countries were in crisis or worse conditions (IPC/CH phase 3 or above), based on the Integrated Food Security Phase Classification (IPC) and Cadre Harmonisé (CH) or comparable sources.¹⁰ In the case of Nigeria, the number of food-insecure populations has been on the increase since 2020. **Figure 1** shows the situation of food insecurity in Nigeria between 2016 and 2022 using data from the 2022 Global Report on Food Crises.¹⁰ The data is comparable for 16 states in Nigeria (out of the 36 states) and the Federal Capital Territory.

Before the peak of the pandemic, that is, between October and December 2019, the number of people in Nigeria that were in CH phase 2 (crisis) or above stood at 4.1 million. The value increased throughout 2020 and

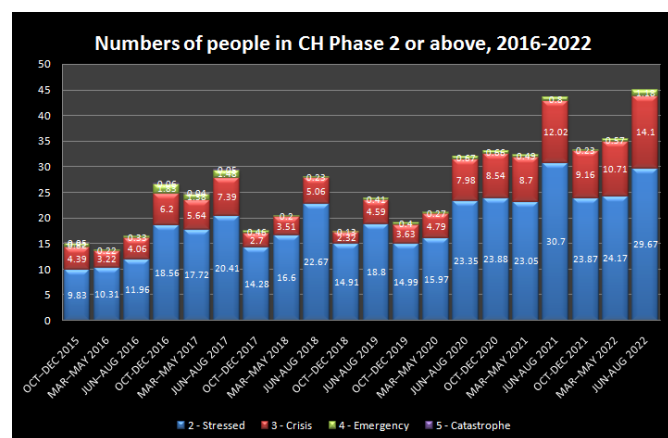


Figure 1 Number of people in Cadre Harmonisé (CH) phase 2 or above 2016–2022.

peak the highest in October–December, with 9.2 million people in crisis or worse phases.

Overall, the COVID-19 pandemic has highlighted the fragility of global food systems and the need for more robust and resilient systems that can withstand disruptions and ensure that all people have access to sufficient, nutritious food. Further, there is no doubt that the ongoing crisis in Ukraine is making it more challenging for countries to recover from the socioeconomic shocks of the pandemic.^{11 12} The surging inflation in many parts of the world has worsened the situation of global food insecurity compared with the pandemic era. This calls for urgent action from governments of food crises countries such as Nigeria, where as many as 19.45 million of the population were projected to face crisis or worse conditions (IPC/CH phase 3 or above) as of June–August 2022, according to the Global Alliance for Food Security.¹³

It is against this background that this study is set to analyse the risk of household food insecurity in Nigeria during the pandemic. Earlier studies obtained evidence of the socioeconomic and demographic factors that accounted for household food insecurity during the COVID-19 crisis.¹⁴⁻²¹ To contribute to this growing knowledge, this study set out to answer the following research questions: (1) What is the prevalence rate of household food insecurity in Nigeria before and during the COVID-19 crisis? (2) What is the distribution of food insecurity by household living conditions in Nigeria? (3) What is the association between household living conditions and food insecurity in Nigeria? We explore the above research questions that form the study objectives using a longitudinal phone survey collected during the COVID-19 crisis. Our investigations inform an understanding of the prevalence and risk of household food insecurity in Nigeria during the novel COVID-19 pandemic and provide insights that can guide policy actions in responding to the current wave of food crises in Nigeria

METHODS

Study design and data source

We use a harmonised dataset of Nigeria's COVID-19 National Longitudinal Phone Survey (NLPS), compiled by the World Bank's Living Standards Measurement Study team.²² The COVID-19 high-frequency phone survey is part of the World Bank's effort to promote data collection on COVID-19 impacts in developing countries and to foster evidence-based policies that can help countries mitigate the devastating effects of the pandemic.²³ The first phase of Nigeria's COVID-19 NLPS lasted from April 2020 to April 2021, during which a representative sample of 1950 households, drawn from the preceding face-to-face survey before the pandemic, was surveyed in 12 consecutive rounds.²⁴

In addition to being the most recent dataset with the potential to reveal the impact of the COVID-19 pandemic in Nigeria, the dataset has additional qualities that make it most suited for this study. First and most importantly

for this study, the harmonised data file contains food insecurity variables that provide useful information on household food security status in Nigeria in the period before and during the COVID-19 pandemic. Second, it contains rich socioeconomic and demographic variables that are useful in deciphering household food insecurity. In addition, the dataset contains a list of indicators that describe the state of household living conditions or well-being. These include indicators of household access to essential facilities such as electricity, clean water, modern housing and improved sanitation; and also the ownership of basic assets such as television, radio, a mobile phone, a motorcycle, etc. Having the above information enables us to examine the objects under study.

Participants

The study participants are restricted to households with complete food insecurity information in all three rounds of our longitudinal survey—the baseline, second and fourth survey rounds. In other words, participants with missing food security data in any of the survey rounds are excluded from the study. Consequently, we used only 1674 panel households out of the 1950 sampled households in the COVID-19 NLPS, excluding 276 with some form of missing data.

Measurement of variables

Household living conditions

Different indicators are recognised in the literature as measures of household welfare or well-being, from the most common income or consumption measures to non-monetary asset-based wealth indices (see Moratti and Natali²⁵ for a review). The use of wealth indices as alternative metrics for measuring well-being is increasingly popular among users of large-scale surveys (eg, Demographic and Health Surveys) that usually lack information on measures of income and/or consumption.²⁶ Such indices have the advantage of being more suitable for analysing multidimensional well-being and are less volatile compared with monetary indices such as consumption, income and/or expenditure.^{27 28} Also, they are less data intensive and easier to calculate^{29–31}; thus, are considered superior alternative metrics for measuring well-being compared with income and consumption.³²

Following common practices in the literature, we identify several items (indicators) in the dataset that can assess household living conditions and aggregate them into a composite index. Our choice of items is guided by what is commonly used in the construction of multidimensional well-being or poverty indexes^{33 34}. Based on the information the dataset provides, we aggregate 14 binary indicators in the dataset into a composite well-being index. **Table 1** describes the indicators used to construct the composite well-being index. The indicators are coded in such a way that desirable outcomes (eg, having access to a clean water supply) take the positive value (ie, equals one) while undesirable outcomes take the null value (ie, equals zero). We construct the index by taking the average

Table 1 Indicators used in constructing the well-being index

Indicators	Number of households (N=1674)%	Item-test correlation
1. Access to modern roof	91.64	0.4819
2. Access to modern floor	82.74	0.5923
3. Access to modern exterior walls	63.32	0.6878
4. Access to improved toilet	67.92	0.5434
5. Access to improved water source	17.32	0.2042
6. Connection to electricity	64.81	0.6758
7. Access to the internet	49.16	0.5646
8. Ownership of mobile phone	85.07	0.4446
9. Ownership of refrigerator	24.31	0.5960
10. Ownership of television	57.29	0.7604
11. Ownership of radio	52.81	0.2913
12. Ownership of car or other vehicles	12.84	0.4652
13. Ownership of generator	33.57	0.6069
14. Ownership of computer	6.15	0.3736
Test scale		0.7967

of the 14 items. The resulting index is bound between 0 (worst) and 1 (best), such that larger values will imply more improved well-being or living conditions.

From **table 1** above, we could deduce that the majority of households in the sample have access to modern building materials such as roofs, floors and walls, as well as improved sanitation. However, quite a few of them (only 17%) have access to improved water sources. For the asset variables, a good number of households own a mobile phone, television or radio, irrespective of who owns it in the household. On the other hand, just 6% own a computer, and 12% own a car or other vehicle, irrespective of who owns it in the household. The item-test correlation result indicates the individual items have a positive correlation with the composite index, with coefficient values between 0.2913 and 0.7604. The Cronbach's alpha coefficient, $\alpha=0.7967$, further indicates that the index has good internal reliability.

Lastly, we assign households to five well-being quantiles or groups—from the first to the fifth quantile. The classification is done in such a way that households with the small index scores, in other words, own or have access to a few of the items belong to the least quantiles, while those with much better scores (ie, own or have access to more of the items) belong to the higher quantiles.

Food security

The harmonised dataset provides measures of household food insecurity, defined as the 'probability of being moderately or severely food insecure' or 'probability of

being severely food insecure'.²² The indicators are binary, coded as 1 if a household's probability of experiencing food insecurity, based on the Food Insecurity Experience Scale methodology, equals or exceeds 50% and 0 if otherwise.²³ For easy identification, we refer to two measures as 'moderate food insecurity' and 'severe food insecurity', respectively. Having these indicators across three rounds of the survey—the baseline survey and two waves of the COVID-19 NLPS—makes our longitudinal study possible.

Other covariates

Welfare literature maintains that household size and composition are important in explaining different aspects of well-being.^{35–36} Empirical findings support the premise that household food insecurity or poverty increases with large households¹⁴ and those living in rural or remote areas.¹⁶ It is also empirically recognised that socioeconomic factors such as the receipt of remittances,³⁷ assistance,^{38–40} access to finances,^{19–21} income^{14–16} and consumption level²³ play a significant role in explaining household food insecurity. Additional evidence in the literature suggests that demographic information about the family head, such as age, gender, marital status, employment and health status, are important elements that explain household food security. In this regard, there are enough findings to suggest that the risk of being food insecure or experiencing food poverty increases for female-headed households,^{14–39–44} household heads not having enough education,^{14–16} those living with disabilities²¹ and those that are unemployed.¹⁴

In addition to the well-being indices, we include a vector of demographic and socioeconomic variables in the regression equation. Our choice of the control variable is motivated by previous empirical evidence on the determinants of household food insecurity. The first set of covariates relates to information about the family head, such as age, gender, literacy, marital status, employment and health status. Next, we account for household characteristics using variables such as household size, consumption level, receipt of assistance, remittances and rental income, place of residence, cultivation of crops and the ratio of household adults working in wage employment, farm employment, or non-farm family establishment. In addition, we include regional dummies for the six geopolitical zones: North Central, North East, North West, South West, South East and South-South.

Statistical methods

To answer the first research question, we calculate the prevalence rate of household food insecurity in the baseline survey (ie, pre-pandemic period) and two waves of the COVID-19 NLPS and test the differences using McNemar's test. Next, we use the Chi-square test to test if the prevalence of food insecurity in each of the survey periods varies across household living statuses. Lastly, we employ the binary logistic regression model to investigate the relationship between household living conditions and food insecurity in different periods of the survey. The

association model between household living and food insecurity is expressed as follows:

$$\text{Food_ins}_t = \delta \text{HH_LivCond} + \gamma' \mathbf{X}' + \mu_i \quad (1)$$

where the outcome variable, Food_ins_t , denotes our measures of household food insecurity (ie, moderate food insecurity and severe food insecurity) and the associated subscript t denotes the survey periods—the baseline survey ($t=0$), the second wave ($t=2$) and the fourth wave ($t=4$). HH_LivCond stands for household living conditions, \mathbf{X}' represents a vector of covariates that enter the model function and μ_i denotes the error term. A logistic expression of the model is as follows:

$$\Pr(\text{Food_ins}_t = \frac{1}{X'}) = \frac{e^{\alpha + \delta \text{HH_LivCond} + \gamma' \mathbf{X}'}}{1 + e^{\alpha + \delta \text{HH_LivCond} + \gamma' \mathbf{X}'}} \quad (2)$$

where $\Pr(\text{Food_ins}_t)$ is the conditional probability of experiencing food insecurity. The logistic transformation of the model is expressed as:

$$\text{logit}(\text{Food_ins}_t) = \ln \frac{p}{1-p} = \ln e^{\alpha + \delta \text{HH_LivCond} + \gamma' \mathbf{X}'} \quad (3)$$

$$\mathbf{X}^* = \alpha + \delta \text{HH_LivCond} + \gamma' \mathbf{X}' \quad (4)$$

The above transformation results in a linear function (\mathbf{X}^*) that is estimated by the method of maximum likelihood. The values of the estimated coefficients reflect the direction of association between the outcome variable and the regressors. Positive or negative coefficient values indicate that the associated variable increases or decreases the likelihood of a household being food insecure. We examined the model fit using the Hosmer-Lemeshow goodness of fit test and attached the results as online supplemental material.

Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting or dissemination plans of our research.

RESULTS

Sample characteristics

The analytic sample comprised 1674 households with complete food insecurity data in the three survey periods of our longitudinal study (see [table 2](#)). The mean value of the composite index (HW_index) is estimated at 0.5064. By well-being groups, 15% of the households belong to the first well-being quantile; 16% belong to the second well-being quantile; approximately 20% are in the third (middle) well-being quantile; 24% belong to the fourth well-being quantile; and 24% are in the fifth well-being quantile. Only 17% of the households in the sample are headed by females, while the average age of household heads in the sample is 48 years. About 78% of the family heads are married; approximately 3% are living with a disability; 82% are literate; and 84% are working or currently employed.

For the remaining covariates, on average, 26% of working adults in the sampled households are working in agriculture, 31% in non-farm family enterprises and

Table 2 Descriptive statistics of the variables

Variable	Definition	Mean	Min	Max
HW_Index	Household well-being index	0.5064	0	1
HW_1st Quant	First well-being quantile	0.1529	0	1
HW_2nd Quant	Second well-being quantile	0.1625	0	1
HW_3rd Quant	Third well-being quantile	0.1977	0	1
HW_4th Quant	Fourth well-being quantile	0.2419	0	1
HW_5th Quant	Fifth well-being quantile	0.2449	0	1
Female	The household head is female	0.1703	0	1
Age	Age of household head (round 0)	48.380	18	99
Married	The household head is currently married	0.7790	0	1
Disability	The household head is with disability	0.0299	0	1
Literacy	The household head is literate	0.8172	0	1
Work	The household head is currently working	0.8393	0	1
Adult_Agr	% of working adults working in agriculture	26.457	0	100
Adult_NFE	% of working adults working in the non-farm family enterprise	31.144	0	100
Adult_Ext	% of working adults working in wage work	15.646	0	100
Hh_Size0	Household size (round 0)	5.6792	1	29
Hh_Size2	Household size (round 2)	6.3596	1	34
Hh_Size4	Household size (round 4)	6.5215	1	34
Finance	Ownership of financial accounts from financial institutions	0.6332	0	1
Remittance	Received remittance	0.3244	0	1
Assistance	Received assistance	0.0968	0	1
Rent	Received rental income	0.0568	0	1
Crop	Crop cultivation	0.6583	0	1
Rural	Place of residence: rural	0.3949	0	1
Cons_	Consumption levels	---	1	5
Zone_	Geopolitical zones	---	1	6

Max, Maximum; Min, Minimum.

approximately 16% in wage employment. The average size of household in each of the survey rounds is 6. On average, 63% of the households own a financial account (regardless of who owns it in the household); 32% received remittances; nearly 10% received assistance from the government or other institutions; 6% received rental income; 66% are agricultural households and 39% live in the rural area.

Prevalence rate of household food insecurity across well-being groups

Table 3 displays the percentage of households that were food insecure during the periods of the survey and across the well-being groups. The results from McNemar's test show a significant difference ($p < 0.001$) in the prevalence of food insecurity in the prepandemic and pandemic periods, that is, between the baseline survey and each wave of the COVID-19 NLPS (The results from McNemar's test are attached as online supplemental materials). For a sample of 1674 households used in the analysis, nearly 32% of them faced some moderate level of food insecurity in the period before the pandemic, compared with 74%

that faced the same degree of food insecurity in the second wave of the COVID-19 NLPS and 72% in the fourth wave of the same survey. Likewise, only 4% of the sampled households were severely food insecure in the prepandemic period, compared with 43% and 22% that experienced a similar magnitude of food insecurity in the period of the pandemic (ie, the second and fourth waves of COVID-19 NLPS).

The χ^2 tests show significant differences in the prevalence of food insecurity across the well-being groups. In the baseline survey, for instance, among households in the fifth well-being quantile, 31.5% were moderately food insecure, compared with 20.7% among households in the first well-being quantile; however, there is no significant difference for the prevalence of severe food insecurity in the same period. The subsequent analysis (rounds 2 and 4) shows a significant difference in the prevalence of food insecurity across household living statuses and that it is increasingly higher for households in the least well-being groups.

**Table 3** Prevalence rate of food insecurity across household living status

Variable name	Definition						
Mod_FIns0	Probability of being moderately/severely food insecure \geq 50% (round 0)						
Sev_FIns0	Probability of being severely food insecure \geq 50% (round 0)						
Mod_FIns2	Probability of being moderately/severely food insecure \geq 50% (round 2)						
Sev_FIns2	Probability of being severely food insecure \geq 50% (round 2)						
Mod_FIns4	Probability of being moderately/severely food insecure \geq 50% (round 4)						
Sev_FIns4	Probability of being severely food insecure \geq 50% (round 4)						
	Total (N=1674)	HW_1st Quant (N=256)	HW_2nd Quant (N=272)	HW_3rd Quant (N=331)	HW_4th Quant (N=405)	HW_5th Quant (N=410)	Pearson χ^2 (p value)
Mod_FIns0	31.84	20.70	25.37	38.07	38.52	31.46	0.000
Sev_FIns0	3.64	4.30	4.41	3.02	2.96	3.90	0.782
Mod_FIns2	73.54	79.69	75.00	80.97	74.81	61.46	0.000
Sev_FIns2	42.59	53.52	45.22	47.43	42.22	30.49	0.000
Mod_FIns4	71.62	81.25	74.26	78.85	72.84	56.83	0.000
Sev_FIns4	21.92	41.80	32.35	23.87	15.80	7.07	0.000

Association between household living conditions and food insecurity

We investigate the risk of being food insecure in three periods of the survey and present the results in tables 4–6. The first two columns in each table present the probability estimates for the risk of being moderately food insecure, while the remaining two columns show the probability estimates for the risk of experiencing severe food insecurity. We begin by estimating the models using the composite well-being index as our measure of household living conditions while controlling for the other covariates (panel A). In subsequent specifications, we estimate the models using the dummy variables for each of the well-being quantiles (omitting the third quantile—the reference category) and control for the same covariates used in the formal analysis, although they are not reported due to space constraints (panel B). The coefficients are reported as average marginal effects after adjusting the standard errors for model misspecification using Stata's 'robust' option. To conserve space, we interpret only covariates that show significant association with the dependent variable at the conventional 10, 5 and 1 per cent levels.

Risk of household food insecurity in pre-pandemic period (baseline survey)

The baseline survey regression (panel A, table 4) shows that the well-being index has a negative association with the probability of experiencing food insecurity in the pre-pandemic period. However, the finding is statistically significant only in the first specification of the moderate food insecurity model. That is, without accounting for household consumption level, the average marginal probability of experiencing moderate food insecurity in the baseline survey (or pre-pandemic period) is predicted to decline by 15.5 percentage points for an additional increase in the value of the composite index. Further

estimations using the well-being quantile (panel B) reveal that households in the first well-being quantile have a greater probability of experiencing severe food insecurity relative to those in the reference category. The finding is consistently significant in both estimations—with or without accounting for household consumption level—with an average probability that increases by 3.44–3.52 percentage points. Conversely, the probability of experiencing moderate food insecurity is significantly lower for households in the fifth well-being quantile, relative to those in the base category.

For the rest of the covariates, the results show that household risk of being moderately food insecure is positively correlated with the household head being female and the size of the household, though the finding loses significance after controlling for household consumption level. There is consistent evidence that rural households are more likely to be food insecure in the baseline survey regressions (ie, the pre-pandemic period). On the contrary, households that cultivate crops, own financial accounts and receive rental income are less likely to experience moderate food insecurity in the pre-pandemic period. Additionally, there is a negative and significant association between the share of adults working in agriculture and household risk of experiencing severe food insecurity in the baseline survey. The evidence is weakly significant at the 10 per cent level of significance.

Risk of household food insecurity during COVID-19 pandemic (round 2)

In table 5, we present the logistic estimates for household risk of being food insecure in the second round of the COVID-19 NLPS survey. The results (in panel A) show a strong negative association between the composite well-being index and household risk of being food insecure in the entire model specification—across all indicators of food insecurity and with or without accounting for

Table 4 Predicted probability of household food insecurity in the baseline survey (round 0)

	Mod_Flns0	Mod_Flns0	Sev_Flns0	Sev_Flns0
Panel A				
HW_Index	-0.155** (-2.13)	-0.0741 (-0.95)	-0.0554 (-1.56)	-0.0437 (-1.15)
Female	0.0723* (1.76)	0.0565 (1.36)	0.0103 (0.63)	0.00472 (0.28)
Age	-0.000134 (-0.16)	-0.0000339 (-0.04)	-0.000316 (-0.90)	-0.000329 (-0.95)
Married	0.00338 (0.09)	-0.00903 (-0.23)	0.00654 (0.42)	0.00152 (0.09)
Disability	0.0911 (1.43)	0.0999 (1.56)	0.0217 (0.99)	0.0217 (0.94)
Literacy	0.00216 (0.07)	0.00702 (0.23)	-0.0135 (-1.05)	-0.0130 (-1.04)
Work	-0.0163 (-0.52)	-0.0159 (-0.50)	0.00531 (0.42)	0.00467 (0.37)
Adult_Agr	-0.0000162 (-0.05)	-0.0000172 (-0.05)	-0.000257* (-1.74)	-0.000248* (-1.68)
Adult_NFE	0.000335 (0.99)	0.000296 (0.87)	-0.000161 (-1.09)	-0.000167 (-1.14)
Adult_Ext	-0.000210 (-0.46)	-0.000201 (-0.44)	-0.000160 (-0.85)	-0.000117 (-0.61)
HH_Size0	0.0103** (2.54)	0.00270 (0.57)	0.00151 (0.94)	0.000467 (0.24)
Crop	-0.0486* (-1.69)	-0.0586** (-2.03)	-0.0147 (-1.24)	-0.0170 (-1.43)
Finance	-0.0780*** (-2.79)	-0.0668** (-2.36)	-0.0109 (-0.85)	-0.0101 (-0.80)
Remittance	-0.0290 (-1.25)	-0.0256 (-1.11)	0.00733 (0.75)	0.00747 (0.77)
Assistance	0.0357 (0.95)	0.0366 (0.98)	0.00766 (0.50)	0.00764 (0.50)
Rent	-0.0960* (-1.95)	-0.0964* (-1.96)	-0.0210 (-0.82)	-0.0190 (-0.74)
Rural	0.0746*** (2.68)	0.0740*** (2.68)	0.0218* (1.90)	0.0212* (1.88)
Cons_	No	Yes	No	Yes
Zone_	Yes	Yes	Yes	Yes
Panel B				
HW_1st Quant	-0.0423 (-1.00)	-0.0647 (-1.52)	0.0352* (1.74)	0.0344* (1.71)
HW_2nd Quant	-0.0423 (-1.15)	-0.0534 (-1.45)	0.0255 (1.42)	0.0243 (1.33)
HW_4th Quant	-0.0236 (-0.75)	-0.0157 (-0.50)	-0.00400 (-0.27)	-0.00305 (-0.21)
HW_5th Quant	-0.0637* (-1.86)	-0.0334 (-0.94)	0.00591 (0.40)	0.0134 (0.83)
Other covariates	Yes	Yes	Yes	Yes
Cons_	No	Yes	No	Yes
Zone_	Yes	\Yes	Yes	Yes
N	1674	1674	1674	1674

t statistics in parentheses *p<0.10, **p<0.05, ***p<0.01.

household consumption level. The average marginal probability of being moderately food insecure in the second round survey is predicted to decline by 28.8 percentage points for an additional increase in the value of the well-being index. The probability value decreases to 25.6 percentage points after controlling for household consumption level. Similarly, without accounting for household consumption, the average probability of experiencing severe food insecurity in the same period is estimated to decline by 40.5 percentage points for an extra increase in the value of the well-being index and by 39.7 percentage points after controlling for household consumption levels.

The lower panel of [table 5](#) (panel B) shows that the probability of being food insecure is much higher for households in the first well-being quantile relative to those in the third well-being quantile (the reference group).

However, the finding is statistically significant only in the severe food insecurity model, with an estimated probability that grows by 7.64–7.72 percentage points. On the other hand, there is enough evidence that households in upper (fourth and fifth) well-being quantiles have less likelihood of being food insecure compared with the reference category. The average marginal probability of experiencing moderate food insecurity, after accounting for household consumption level, is estimated to decline by 60.5 percentage points for households in the fourth well-being quantile, and 13.7 percentage points for households in the fifth well-being quantile. In the same vein, the average probability of being severely food insecure in the same period after accounting for the level of consumption declines by 14.6 percentage points for households in the fifth well-being quantile relative to the base category.

**Table 5** Predicted probability of household food insecurity in the second survey (round 2)

	Mod_Flns2	Mod_Flns2	Sev_Flns2	Sev_Flns2
Panel A				
HW_Index	-0.288*** (-4.28)	-0.256*** (-3.63)	-0.405*** (-5.15)	-0.379*** (-4.58)
Female	-0.0451 (-1.01)	-0.0590 (-1.31)	-0.110** (-2.21)	-0.123** (-2.41)
Age	-0.000927 (-1.07)	-0.000950 (-1.10)	-0.000672 (-0.70)	-0.000700 (-0.73)
Married	-0.0701* (-1.72)	-0.0844** (-2.05)	-0.0554 (-1.23)	-0.0676 (-1.45)
Disability	0.0224 (0.34)	0.0243 (0.36)	0.00199 (0.03)	0.00393 (0.05)
Literacy	-0.0307 (-0.93)	-0.0291 (-0.87)	-0.0574* (-1.66)	-0.0572* (-1.65)
Work	0.00397 (0.12)	0.000102 (0.00)	-0.0471 (-1.28)	-0.0501 (-1.36)
Adult_Agr	0.000384 (1.01)	0.000409 (1.08)	0.000431 (1.06)	0.000455 (1.12)
Adult_NFE	0.000182 (0.50)	0.000151 (0.42)	0.00113*** (2.84)	0.00111*** (2.77)
Adult_Ext	-0.000963** (-2.25)	-0.000894** (-2.09)	0.0000772 (0.15)	0.000137 (0.26)
HH_Size2	0.00335 (0.95)	0.00159 (0.43)	0.00102 (0.25)	-0.000795 (-0.18)
Crop	-0.0143 (-0.50)	-0.0233 (-0.81)	-0.0211 (-0.62)	-0.0298 (-0.87)
Finance	-0.0551* (-1.92)	-0.0515* (-1.77)	-0.0290 (-0.92)	-0.0247 (-0.78)
Remittance	-0.00389 (-0.17)	-0.00406 (-0.17)	-0.00567 (-0.21)	-0.00576 (-0.22)
Assistance	0.0459 (1.17)	0.0431 (1.10)	0.0420 (1.00)	0.0404 (0.96)
Rent	-0.0903** (-2.15)	-0.0840** (-1.97)	-0.0997* (-1.80)	-0.0955* (-1.71)
Rural	0.0212 (0.81)	0.0211 (0.80)	0.0437 (1.39)	0.0439 (1.39)
Cons_	No	Yes	No	Yes
Zone_	Yes	Yes	Yes	Yes
Panel B				
HW_1st Quant	0.00949 (0.22)	0.0101 (0.23)	0.0772* (1.73)	0.0764* (1.68)
HW_2nd Quant	-0.0460 (-1.17)	-0.0470 (-1.19)	-0.0119 (-0.29)	-0.0148 (-0.36)
HW_4th Quant	-0.0627* (-1.86)	-0.0605* (-1.78)	-0.0611* (-1.65)	-0.0587 (-1.57)
HW_5th Quant	-0.152*** (-4.60)	-0.137*** (-4.01)	-0.160*** (-4.04)	-0.146*** (-3.55)
Other covariates	Yes	Yes	Yes	Yes
Cons_	No	Yes	No	Yes
Zone_	Yes	Yes	Yes	Yes
N	1674	1674	1674	1674

t statistics in parentheses *p<0.10, **p<0.05, ***p<0.01.

Additional findings from the results in [table 5](#) show that household risk of experiencing moderate food insecurity in the second round of the COVID-19 NLPS has a negative association with the household head being married, the share of wage earners, and ownership of the financial account. At the same time, the results infer that households headed by females and literate are less likely to be severely food insecure in the same survey period. Also, there is significant evidence across the model specifications that households with a record of receiving rental income have less probability to be food insecure in the same survey period. On the contrary, the risk of experiencing severe food insecurity is positively correlated with the percentage of working adults working in the non-farm family enterprise.

Risk of household food insecurity during COVID-19 pandemic (round 4)

[Table 6](#) contains the regression estimates for the probability of experiencing food insecurity in the fourth round of the COVID-19 NLPS survey. In line with the preceding findings, there is a strong negative relationship between the composite well-being index and household food insecurity in the entire analysis. Without accounting for household consumption, the estimated probability value of the well-being index equals -0.377 in the moderate food insecurity regression and -0.368 in the severe food insecurity regression. The values decrease in absolute terms to -0.307 and -0.343 when we add the consumption level controls to the specifications. Further investigation using the household well-being quantiles (panel B) supports the earlier established evidence that households in the least state of well-being have a higher probability of

Table 6 Predicted probability of household food insecurity in the fourth survey (round 4)

	Mod_Flns4	Mod_Flns4	Sev_Flns4	Sev_Flns4
Panel A				
HW_Index	-0.377*** (-5.39)	-0.307*** (-4.16)	-0.368*** (-5.98)	-0.343*** (-5.35)
Female	-0.0492 (-1.06)	-0.0702 (-1.52)	-0.0568 (-1.26)	-0.0654 (-1.41)
Age	-0.0000660 (-0.07)	-0.00010 (-0.12)	-0.00222*** (-2.86)	-0.00223*** (-2.86)
Married	-0.0782* (-1.87)	-0.104** (-2.47)	0.0161 (0.41)	0.00727 (0.18)
Disability	0.00600 (0.09)	0.0128 (0.20)	-0.00437 (-0.08)	0.00297 (0.06)
Literacy	-0.0425 (-1.26)	-0.0376 (-1.12)	-0.0379 (-1.41)	-0.0375 (-1.41)
Work	0.0135 (0.39)	0.00875 (0.26)	-0.0473* (-1.66)	-0.0484* (-1.68)
Adult_Agr	-0.000577 (-1.56)	-0.000522 (-1.43)	0.0000987 (0.33)	0.000114 (0.38)
Adult_NFE	-0.000203 (-0.57)	-0.000211 (-0.59)	0.000524* (1.65)	0.000509 (1.59)
Adult_Ext	-0.000837* (-1.89)	-0.000747* (-1.70)	-0.000566 (-1.15)	-0.000528 (-1.07)
HH_Size4	0.00374 (1.02)	-0.000217 (-0.06)	0.00564** (2.10)	0.00383 (1.30)
Crop	-0.0303 (-1.03)	-0.0448 (-1.50)	0.000110 (0.00)	-0.00621 (-0.21)
Finance	-0.0413 (-1.42)	-0.0334 (-1.14)	0.0105 (0.44)	0.0155 (0.65)
Remittance	-0.0170 (-0.72)	-0.0157 (-0.67)	0.0272 (1.24)	0.0273 (1.24)
Assistance	0.0695* (1.73)	0.0640 (1.60)	0.0272 (0.93)	0.0242 (0.82)
Rent	-0.0640 (-1.49)	-0.0541 (-1.26)	-0.0249 (-0.51)	-0.0190 (-0.39)
Rural	-0.0263 (-1.00)	-0.0267 (-1.01)	0.0158 (0.59)	0.0168 (0.62)
Cons_	No	Yes	No	Yes
Zone_	Yes	Yes	Yes	Yes
Panel B				
HW_1st Quant	0.0369(0.81)	0.0277 (0.60)	0.0602* (1.94)	0.0561* (1.78)
HW_2nd Quant	-0.0411 (-1.05)	-0.0442 (-1.13)	0.00526 (0.18)	0.00285 (0.10)
HW_4th Quant	-0.0496 (-1.44)	-0.0416 (-1.21)	-0.0676** (-2.27)	-0.0644** (-2.16)
HW_5th Quant	-0.163*** (-4.83)	-0.134*** (-3.88)	-0.193*** (-5.11)	-0.181*** (-4.66)
Other covariates	Yes	Yes	Yes	Yes
Cons_	No	Yes	No	Yes
Zone_	Yes	Yes	Yes	Yes
N	1674	1674	1674	1674

t statistics in parentheses *p<0.10, **p<0.05, ***p<0.01.

experiencing severe food insecurity relative to those in the reference group, while on the contrary, the probability is much lesser for households in a better state of well-being. The average marginal probability of being severely food insecure, after accounting for household consumption level, is estimated at 0.0561 for households in the first well-being quantile. Meanwhile, the same probability is estimated at -0.0644 for households in the fourth quartile and -0.181 for households in the fifth quantile.

Among the rest of the variables included in the analysis, the results in [table 6](#) indicate that the risk of being severely food insecure in the fourth round of the COVID-19 NLPS is negatively associated with household head characteristics like age and marital status, while positively correlated with household size and the number of wage workers. However, the latter finding loses significance after accounting for household consumption levels

in the analysis. Additional evidence from the analysis suggests that household risk of being severely food insecure is positively correlated with the receipt of assistance and the share of adults working in wage employment. However, the finding on the receipt of assistance loses significance after we added household consumption level in the analysis.

Diagnostic test

The Hosmer-Lemeshow goodness of fit test results indicate that the models have a good fit (The results are attached as online supplemental materials).

DISCUSSIONS

This study contributes to the growing knowledge of household food insecurity during the novel COVID-19



pandemic. Using a harmonised dataset of Nigeria's prepandemic face-to-face survey and two waves of the COVID-19 NLPS, we analyse the prevalence of food insecurity in Nigeria before and during the COVID-19 pandemic. Our analysis recorded a significant increase in the number of food-insecure households during the COVID-19 crisis relative to the prepandemic period. Thus, for a sample of 1674 households used in the analysis, only 32% were at moderate risk of food insecurity in the baseline survey (or prepandemic period), compared with 74% and 72% at such risk in the second and fourth waves of the COVID-19 survey. In like manner, not up to 4% of the households faced severe food insecurity in the baseline survey, compared with 43% and 22% that experienced the same magnitude of food insecurity in the period of the COVID-19 pandemic (or waves of the COVID-19 survey). This shows that the levels of food insecurity substantially increased in Nigeria at the point when COVID-19 was rife and beyond⁴ and has continued in contemporary times.^{10 13} The outcome of this study does agree with some recent studies across regions.⁴⁻⁶ Succinctly, a study in Uttar Pradesh, India, reported that household food insecurity in the region increased from 21% in the prepandemic period to 80% during the pandemic, with 62% of the food-secure households in the initial period turning out to be food insecure during the pandemic.⁶

In the later part of the study, we investigate the association between household living conditions and food insecurity in each of the survey periods—the baseline and two waves of the COVID-19 NLPS. We begin by constructing a composite non-monetary measure (or index) of household well-being using the available information in the dataset. Relative to conventional measures of well-being, particularly income and consumption, the constructed measure of household well-being in this study has the advantage of being more suitable for analysing multidimensional or non-monetary well-being and is less volatile to external shocks.^{26 27} However, our approach to constructing the well-being index is driven by data availability and lacks rigorousness for a multidimensional measure of well-being.

Our investigations inform our understanding of how the risk of food insecurity varies across categories of household well-being in Nigeria during the COVID-19 pandemic. First, we observe an increasing food insecurity status among households in relatively poor living conditions (ie, those in the first and second well-being quantiles) compared with their upper quantile counterparts. For the risk of experiencing food insecurity, we establish a strong negative relationship between the well-being index and household probability of experiencing food insecurity, most significant in the pandemic specifications. Further investigation reveals that the risk of being food insecure increases for households with poor well-being or living conditions relative to those in the middle category and conversely declines for households in much better living conditions.

Addressing food insecurity, at least in the short and medium terms, requires that food (or other social assistance) be provided for the vulnerable population—individuals suffering from food insecurity. Although not within the scope of this study, existing evidence suggests that social security or assistance plays a meaningful role in mitigating the effects of negative life events. In India, for instance, it was observed that social safety programmes in the form of cash transfers helped protect households from food insecurity during the COVID-19 crisis.³⁷ A similar study for 11 different countries during the pandemic argued that cash safety nets were more effective in addressing food insecurity than food assistance³⁸; while in Malawi it was observed that assistance-recipient households have a lower probability of engaging in coping strategies during the pandemic, particularly, reducing food consumption or depending on savings.³⁹

However, an issue of concern that calls for urgent attention is the low coverage of social protection programmes in Nigeria. It is quite surprising to know that only 4% of households in Nigeria received social assistance in the form of direct cash transfers during the pandemic,²³ with less than 10% of the households in our analytical sample having a record of receiving assistance either from the government or an institutional body (table 2). Reactive attempts to contain the burden of food insecurity during the pandemic pre-empted households from finding solace in cost-effective coping strategies, such as reducing food and dietary consumption, which has a long-lasting effect on welfare.²³

To this end, we call for a 'robust' social protection system that, beyond responding to food (or any) crises in the country, will ensure no one is left behind, most especially among individuals or households in the least well-being group, which, according to our findings, are vulnerable to food insecurity during unexpected emergencies such as the COVID-19 pandemic. Beyond this, more efforts must be geared toward improving household living conditions through improved access to essential infrastructures such as electricity, clean water supply, improved sanitation and an internet connection, which are very essential for meeting basic needs and pursuing economic activities.

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National Longitudinal Phone Survey (COVID-19 NLPS) 2020 - World Bank Living Standards Measurement Study Harmonized Dataset and available at <https://microdata.worldbank.org/index.php/catalog/3856>.

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Supplementary Materials

Appendix 1: McNemar's test results

Two-Periods Comparison	McNemar's chi2(1)	Prob > chi2	Exact McNemar significance probability
Round0 vs. Round2 (Mod_Fins)	562.59	0.0000	0.0000
Round0 vs. Round2 (Sev_Fins)	607.29	0.0000	0.0000
Round0 vs. Round4 (Mod_Fins)	511.01	0.0000	0.0000
Round0 vs. Round4 (Sev_Fins)	238.87	0.0000	0.0000
Round2 vs. Round4 (Mod_Fins)	3.03	0.0818	0.0916
Round2 vs. Round4 (Sev_Fins)	222.52	0.0000	0.0000

Source: Authors' Computation (2022)

Appendix 2: Hosmer–Lemeshow test (H-L test) results

		Column 1	Column 2	Column 3	Column 4
Table 4 (Panel A)	Prob > chi2	0.9876	0.7817	0.5188	0.3670
Table 4 (Panel B)	Prob > chi2	0.9185	0.3586	0.7655	0.3380
Table 5 (Panel A)	Prob > chi2	0.2408	0.5937	0.3462	0.1443
Table 5 (Panel B)	Prob > chi2	0.9102	0.3693	0.0457	0.3177
Table 6 (Panel A)	Prob > chi2	0.3889	0.1696	0.3443	0.9805
Table 6 (Panel B)	Prob > chi2	0.8276	0.6223	0.9639	0.9157

Source: Authors' Computation (2022)