Effects of Covid-19 Induced Spike in Food Prices on Urban Households' Food Security in Northwest, Nigeria

(Research Article)
Doi: 10.29023/alanyaakademik.1099349

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How to cite this article: Idakwo, D.A., Oladimeji, Y.U., Ayanlere, A.F., & Hussaini, A.S., (2022). Effects of Covid-19 Induced Spike in Food Prices on Urban Households' Food Security in Northwest, Nigeria. Alanya Akademik Bakış, 6(3), p.3009-3028.

ABSTRACT

The purpose of the study is to assess the effects of COVID-19 induced spike in food prices on urban households' food security status in Northwest, Nigeria. Primary data through structured questionnaires were collected for the study. A multistage random sampling resulted into sample size of 240 urban households (samples). Primary data was used for the study. The results of variables used for the fixed effect regression shows that the mean price was ₦200, average household size was 7 persons per household, the average age and education was 45 and 10 years, respectively. The results of price trend before and during COVID-19 pandemic shows significant differences in all the four (4) cereal crops investigated. The result of the food security levels of households reveals that majority of the households (95%) were food secure before the outbreak of COVID-19 while the food secure households dropped to 78% during COVID-19. The fixed-effects regression shows that the coefficients of price (1.05), household size (0.02), COVID-19 loan (-0.134e-7) and household income (0.015) were found to have statistically significant effects on food security status of households. The findings from this study will help guide governments at various levels in Nigeria in policy formulation towards ameliorating the sufferings of households in the study area. In addition, NGOs and other concerned local and international organisations can rely on this study as a guide for distributing COVID-19 relief find and further research.

1. INTRODUCTION

The Covid-19 pandemic has brought along an untold hardship on humanity. Presenting itself as both health and human crisis, it has placed the food security and nutrition of millions of people in Northwest Nigeria under serious threat (United Nations, 2020). Before the emergence of Covid-19, fighting hunger and insecurity among the Nigerian populace has been one difficult task confronting the Nigerian government. Aside inflation, Nigeria's Gross Domestic Product (GDP) has been declining lately, with its growth rate plunging from 6.5% in 2014 to less than 1.8% in 2018, fueling poverty and extreme hunger in the country (Onyibe, 2019). This trend nosedived even further as the country was thrown into recession in 2020 due to the impact of the Covid-19 pandemic. Since the first case of Coronavirus was reported in Nigeria on February 27, 2020, an unprecedented economic situation has followed, giving rise to skyrocketing food prices in the country. Food security in Nigeria is under serious threat and food prices have been rising drastically, and in most cases recording almost double due to the impact of economic lockdown and social distancing imposed by various governments as measures to curtail the spread of Coronavirus. Other factors such as banditry (Ladan and Matawalli, 2020), farmers-herders conflict, market failures, climate change (Kalkuhl et al., 2016; Amolegbe et al., 2021), political instability (Minot, 2014) and the presence of weak institutions (Bora et al., 2011; Amolegbe et al., 2021) were also common factors responsible for food price increase and rising fluctuation.

To improve the food security situation in Nigeria, successive governments over the years have initiated various policies to unleash the potentials of the country's agricultural sector to feed its nation (Nwankpa, 2017) and as such to reduce hunger among the poor and vulnerable people. Some of these policies include National Economic Empowerment and Development Strategy (NEEDS) in 1999, National Special Programme on Food Security (NSPFS) in 2002, Agricultural Transformation Agenda (ATA) in 2012, Agriculture Promotion Policy (APP) in 2016, to mention a few. Several international and non-governmental organisations (NGOs) such as World Bank (WB), Food and Agriculture Organization (FAO), Africa Development Bank (ADB), International Institute for Tropical Agriculture (IITA), International Crops Research Institute for the Semi-Arid Tropics (ICRISTAT), and Alliance for a Green Revolution in Nigeria (AGRA) among others, have also collaborated with the Nigerian government to reduce food insecurity and poverty. However, the number of people living with hunger in Nigeria has been rising rapidly despite government efforts to boost food production (Kralovec, 2020).

The ugly trend of increasing food prices which was already evident during the early phase of economic lockdown introduced by the federal government of Nigeria, became worse off as the lockdown extended deeper into several months. The lockdown introduced by the respective governments at both state and federal level, on one hand, disrupted the food supply chain by causing reduced output and hindering the flow of goods and services (Cappelli and Cini, 2020; Cullen, 2020; Akter, 2020). On the other hand, it pushed households to engage in panic buying, leading to a surge in demand (Power et al., 2020; Bhattacharjee and Jahanshah 2020; Akter, 2020). The combined effect of supply disruption and demand surge is short-term food price inflation (Akter, 2020), which is credited to the Covid-19 pandemic.

Rising food prices reduces total disposable income available for households and add to the financial burden being experienced by households (Sekhampu and Dubihlela, 2012), forcing households in the states to reduce their non-food expenditure, and in some cases increase consumption of low-quality staple. A larger percentage of their disposable income is now being

spent on food consumption. Often, the burden of food price hikes is borne more by the poor and vulnerable households who spend up to 80% of their income on food expenditure (Obayelu, 2010; Shittu et al., 2018). During periods of massive negative price or income shocks, reduction in food budget is often the most immediate action taken by these households, and this aggravates the problem of food insecurity.

Presently, despite the economy being completely opened for business activities, food prices still maintain their high status. This has triggered serious concerns from the masses about the present government resolve to take a 100 million Nigerians out of poverty before the end of the present administration. As such, this study is being undertaken to analyze the true picture of the effects of the Covid-19 induced spike in food prices on urban households' food security in Northwest, Nigeria. This is critical for designing effective policies and interventions to mitigate the adverse effects of spike in food prices on households' food security in Northern Nigeria.

1.1. History of Pandemic

Pandemic can be defined as an epidemic stretching across nations (globally), or crossing international boundaries and often affecting a multitude of people (Kelly, 2011). All over known, mostly Western reports, there have been documented accounts of pandemics that each affected humanity, not excluding redefining the very basic approaches employed by modern health sciences. A brief outline of major pandemic outbreaks throughout recorded history which extend to the present twenty-first century is given below:

1.1.1. The Athenian plague of 430 BC – This occurred during the Peloponnesian War which fought between city-states of Athens and Sparta. Within 3 years of its outbreak, most of the populace were already infected by this disease, and shocking as many as 75,000 to 100,000 people, representing 25% of the entire Athens' population died (Littman, 2009). The historic record of the Athenian plague was provided by Thucydides, who pulled-through the disease himself and narrated it in his history of the Peloponnesian War. This disease originated in Ethiopia, after which, it was transmitted to Egypt and then Greece. Early manifestation of this disease included conjunctivitis, headache, rashes all over the body, and fever.

1.1.2. The Antonine plague – This was another outbreak that happened a number of centuries passed that was reported and recorded by medical practitioners of the time. It was known as the Antonine Plague of 165–180 AD and the physician who recorded it was Galen. Another name given to this outbreak was the Plague of Galen (Horgan, 2019). The Antonine plague had its epicenter in the Roman Empire as at the time Marcus Aurelius (161–180 A.D.) was in power. It was learnt to be caused by smallpox. It was transmitted into the Empire by soldiers coming back from Seleucia, later spread to Asia Minor, Egypt, Greece, and Italy. The Antonine plague stretch through the immense region of the entire Roman Empire, reason being that the Empire was popular for its economic and political activities, and was covering an extensive area of the state. The Anthonine disease outbreak caused death of one-third of the population in several areas, and devastated the Roman army, causing the death of the king himself, Marcus Aurelius.

1.1.3. The Justinian plague – This pandemic was caused by Yersinia Pestis which occurred in mid-sixth century AD somewhere in Ethiopia, cutting across Egypt, and in Central Asian. It was then transmitted through the caravan as a result of business activities through that path. Via either of these locations, the plague rapidly spread across the Roman empire to other nations. In the same pattern as other pandemics, this plague infected people along the trading routes as goods exchanged hands and therefore, was mostly fatal to cities along shores. In addition, movement of Military from through various locations helped in the spread of the

disease at the time from Asia to Italy, Western Europe and Africa. The Justinian epidemic is the earliest clearly documented example of the actual (bubonic) plague outbreak.

1.1.4. The Black death – This pandemic turned into a worldwide outbreak of bubonic plague that originated in China in 1334, entered Europe in 1347 (Huremovic, 2019). Within 50 years of its reign, it decreased the worldwide populace from 450 million to under 350 million, likely beneath three hundred million, with the pandemic killing as much as a hundred and fifty million. Some records shows that the Black Death claimed as much as 60% of lives in Europe at that time. Starting in China, it spread across Asia and northern India following the installed buying and selling course referred to as the Silk Road. The plague reached Europe in Sicily in 1347. Within five years, it had been transmitted across the entire continent, infesting people in Russia and the Middle East. In its first wave, it claimed 25 million lives. The direction and signs of the bubonic plague had been dramatic and terrifying. Boccaccio, one of the many creative contemporaries of the plague, defined it as follows: it starts off with the emergence of positive tumours around the groin or armpits, a number of which grew as huge as an apple, others taking the shape of eggs. From these parts of the body this lethal disease quickly started to propagate and unfold itself in other body parts. Black Death showed the position of pathogens in pandemics of human history (Green, 2015).

1.1.5. "Spanish Flu" pandemic 1918–1920 – This pandemic occurred in the first decades of the twentieth century. Records show that it was the first worldwide pandemic and the first to occur in modern day medicine. Special attention was given to this pandemic by special units of medicine such as infectious diseases and epidemiology studying the nature of the ailment and the organisms responsible for the outbreak as it spread across the world. People were killed in their millions especially in Spain and other regions of the universe. The population growth index of Spain became negative for the year 1918 due to the unprecedented large number of deaths recorded as a result of the outbreak (Trillia et al., 2008). This era was the last verifiable global pandemic with an extensive impact on all societies scattered all through the earth. The H1N1 strain of the influenza virus was discovered to be the cause of this disease. This strain had an encore outbreak in the early beginning of the twenty-first century. However, the peak period of deaths recorded was in October 1918, for the USA and Italy (Gavrilova and Gavrilov, 2020).

1.1.6. HIV pandemic – The HIV pandemic is referred to as HIV/AIDS and was a gradually progressing worldwide pandemic spreading via a long period of time, across continents and the human race. It was documented to have begun in the early Nineteen Eighties in USA, infecting people and arousing public anxiety. HIV during that time gradually progressed to AIDS and unfortunately, to death. This virus, during this time was observed to have spread more within the homosexual populace, causing excessive deaths. People who contracted this virus were known to be largely stigmatized against causing them to stay isolated. HIV is said to have infected approximately forty million humans globally (occurrence rate: 0.79%) and has caused the death of nearly same figure of humans since it outbreaks in 1981. Deaths recorded from this virus is approximately 1,000,000 each year worldwide (down from close to two million in 2005). While it represents a worldwide public situation, the HIV epidemic is mainly severe in a few Sub-Saharan African countries such as Botswana, Lesotho, and Swaziland, where infection rate is about 25%. In the USA, approximately 1.2 million humans are carrying the HIV virus and approximately 12,000 die each year (down from over 40,000 in the early1990s). HIV within the USA disproportionately hugely affect the gay population, transgendered women, and black Americans. Being a slowly spreading pandemic, HIV has been given much needed public attention, either locally or internationally by administrators and pharmaceutical

firms. As such, there have been huge success stories in its treatment (protease inhibitors and anti-retrovirals).

1.1.7. Severe acute respiratory syndrome (SARS) – This was the first infectious disease outbreak in the twenty-first century that got the world's attention. It was reported to have been caused by SARS Corona virus (SARS CoV). China is where this deadly disease started from and infected more than 10,000 people, predominantly in China and Hong Kong. Some cases were also reported in other countries, such as 251 cases of infection reported in Canada (Toronto). A severity of of about 10% of respiratory symptoms and mortality rate was reported. This pandemic gradually became a worldwide public health issue. As such all public health bodies took up a strong campaign against its spread which yielded great results in helping to avert its spread to other parts of the world, and eventually in the mid-2003 was contained.

1.1.8. "Swine Flu" or H1N1/09 pandemic – This was very similar to the "Spanish flu" pandemic from 1918, except for its far less fatal consequences. It was suspected to be a mutated version of bird, swine, and human flu viruses, it was informally called the "swine flu" (Huremovic, 2019). Its first case of infection was traced to Mexico in 2009 and attained the pandemic level within few weeks. It spread rapidly as the year progresses and by May of 2010 it was declared pandemic. Over 10% of the world's population contracted the virus, with a total mortality of estimated between 20,000 to 500,000 people. However, death rate from this pandemic was far less than the regular influenza death rates. Contrary to earlier fears that mortality rate would be very high because it largely affected young and healthy adults, and usually causing acute respiratory difficulty.

1.1.9. Ebola outbreak (2014–2016) – Ebola virus belongs to the Filoviridae family. Five known strains have been identified: Sudan, Zaire, Bundibugyo, Reston and Taï Forest. However, only three cause the majority of sickness in humans with fatality rates of 25% to 90% (Coltart et al., 2017). This virus is endemic to Central and West Africa, with fruit bats suspected to be a likely reservoir. This outbreak was documented to have begun in a rural settlement in Guinea in December 2013. Swiftly, it was transmitted among families, soon reaching Liberia and Sierra Leone. In these two countries it became a huge outbreak causing considerable number of deaths and maintained its presence for several months. More than 28,000 reported cases and over 11,000 death was documented (Huremovic, 2019). Few cases were observed in Mali and Nigeria, but were, however, subdued immediately. This 2013 Ebola outbreak happens to be the largest outbreak of the disease to date, and caused global scare in September of 2014 after a traveler from Liberia took ill and passed on in Texas. The two nurses who attended to him contracted the virus and this led to speculations that an outbreak in the USA is imminent. As result, immediate actions were taken by the USA health authorities and military to address and help contain any eventual identified case on site (Operation United Assistance). However, outside these two cases no further known case was reported.

1.1.10. Covid-19 pandemic – This happens to be the latest pandemic, still very active and ravaging every continent of the world. It is caused by coronavirus. The first reported case can be traced to Wuhan City in China, in December 2019 (Liu, 2020). Common symptoms of patients suffering from this sickness, include dry cough, fever, malaise, dry cough, and dyspnea. Earlier, the disease was referred to as Wuhan pneumonia by the press since it was first identified in Wuhan and patients exhibit pneumonia symptoms. The Coronavirus responsible for this sickness is the seventh member of the coronavirus family to infect humans. As the virus spread across the universe, the World Health Organization (WHO) soon referred to this new virus as 2019 novel corona-virus (2019-nCoV) on 12 January 2020 and later formally declared this infectious disease corona-virus disease 2019 (COVID-19) on 12 February 2020. Since

COVID-19 emerged in China, it has mutated through several months and countries, spreading from countries to countries and the whole world dealing with it as a common threat. The WHO finally declared COVID-19 a pandemic on March 11, 2020, in line with the 1918 Spanish flu (H1N1), 1957 Asian flu (H2N2), 1968 Hong Kong flu (H3N2), and 2009 Pandemic flu (H1N1), which resulted in an estimated 50 million, 1.5 million, 1 million, and 300,000 human deaths, respectively. The SARS-CoV-2 infection which causes Covid-19 has already been reported in every continent of the world. At the moment, June 8, 2021, the virus has led to over 173 million infections and above 3.7 million deaths.

2. LITERATURE REVIEW

Several studies carried out in Nigeria and few other countries have documented the role of Covid-19 and food price spikes on households with respect to food security.

Kansiime et al. (2021) studied the effects of the Coronavirus disease (Covid-19) pandemic on households' income and food security in two East African countries – Kenya and Uganda. Their findings showed that; over two-third of the sample used witnessed sharp decline in their income due to the Covid-19 pandemic. Food security and food quality eaten became low, as ascertained by the food insecurity experience scale and the frequency of consumption of nutritionally-rich foods. The portion of food insecure interviewee rose by 44% and 38% in Uganda and Kenya, respectively and in the two countries, the frequent consumption of fruits reduced by approximately 30% during the pandemic, compared to period before the pandemic. In addition, poor income households and those dependent on labour income were more vulnerable to income shocks, and had inferior food consumption during the Covid-19 pandemic compared to other respondent groups.

Schmidt et al. (2021) in their research work deduced that, 25% increase in the global price of rice would lower total rice purchased in Papua New Guinea by 14% and lessen rice eaten by the poor (bottom 40% of total household expenditure distribution) by 15%. Adding the effects of perhaps 12% reduction in household incomes due to Covid-19 related economic decline, rice consumed by urban and rural poor reduced by 20% and 17%, respectively.

Egger et al. (2021) revealed in their research work conducted using 30,000 respondents in household surveys from nine countries in Asia and Latin America that there was decline in employment and income in all settings beginning from March 2020. The portion of households witnessing an income decline ranges from 8 to 87%. Coping measures adopted by households and government interventions were inadequate to sustain precrisis standards of living, which resulted in widespread food insecurity, higher poverty and alarming economic conditions even 3 months into the crisis.

Ibukun and Adebayo (2021), reported in their research work using Covid-19 National Longitudinal Phone Survey (Covid-19 NLPS) data, where they analyzed the data using descriptive statistics, bivariate as well as multivariate analysis that about 12% of the samples were food secure, 5% were mildly food insecure, 24.5% were moderately food insecure and over half of the sampled households (58.5%) witnessed acute food insecurity. The result from their ordered probit regression highlighted socioeconomic variables (education, wealth status and income) as the main determinants of food security during the pandemic. In addition, they pointed out that over two-thirds of households were facing the threat of food insecurity in Nigeria. The findings singled out the flagrant inadequacy of government palliative support and distribution.

Akter (2020), in his work where he analyzed the impact of Covid-19 related 'stay-at-home' restriction on food prices in Europe, showed that: the relationship between food prices and stay-at-home curtailment was significant after guiding against cross-country variations in Covid-19 related setbacks and other alleviation and adaptation measures, such as international travel controls, road closures and the size of the economic stimulus packages. His study revealed an empirical evidence of food price inflation as an unplanned aftermath of Covid-19 pandemic restriction strategies in one of the most fatally hit continents of the world.

Shittu et al. (2018) undertook a detailed study on "effects of Food Price Spikes on Household Welfare in Nigeria". Their findings indicate that higher spike in the price of cereals often has negative effect on quantity of food (including calories) eaten, dietary diversity, and income welfare of households. Spikes of price of other commodities, animal proteins, fats and oils, fruits and vegetables exert heterogeneous influence. More findings suggest that food distribution may be more effective in enhancing welfare of households than direct cash transfers. Efforts to alleviate acute spikes in the prices of household commodities (especially cereals) are important for enhanced food security, nutrition and overall household standard of living.

2.1.. Justification of the Study

Follow from above, literature have pointed out that COVID-19 pandemic has deepened the food crisis. As such, impacts are expected to be most severe for poorer households in both rural and urban areas (Ericksen et al. 2010; Ravallion et al. 2020; Mobarak and Barnett-Howell, 2020; Amare et al. 2020). This is what the study intended to dwell on. The increase in food prices represents a major crisis for the world's poor (Wodon and Zaman, 2008). More so, the high food prices and decreasing incomes are reducing poor households' purchasing power, especially for those in Northwest Nigeria conflict-affected areas. The higher food prices lead to a change in consumption patterns, as households resort to consuming less and buying food of lower quality. The increased food expenditure makes them more sensitive to any increase in food prices (Yousif and Al-Kahtani, 2013) and households end up with less disposable income for other household necessities.

As such, in Nigeria, it is important to undertake this study to examine the resulting spike in food prices precipitated by the Covid-19 pandemic in north-west Nigeria as this will give an understanding of how this phenomenon affects urban households' food security and poverty status, and will provide a direction to aid policy formulation by government agencies and other concerned actors to help mitigate the effects of the resulting spike in food prices. This could help the government achieve its goal of lifting a 100 million Nigerians out of poverty as planned when it stepped into power in 2015.

2.2. Hypotheses of the Study

The following null hypotheses were tested for this study:

i) H_0 - there is no significant difference in the prices of the selected commodities before and during COVID-19 pandemic, and

ii) H_0 – there is no significant difference in the food security levels of households before and during COVID-19 pandemic.

3. RESEARCH METHODOLOGY

3.1. Study Area

The study was carried out in Northwest Nigeria (Figure 1), which is one of the geopolitical zones in the country (NBS, 2020). It is made up of seven (7) states out of 36 states in Nigeria- Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara and predominantly populated by the Fulani and Hausa people (NPC, 2006). The zone has a projected population of 54,090,075 people in 2021 at a growth rate of 3.2% per annum (Magaji, 2021).
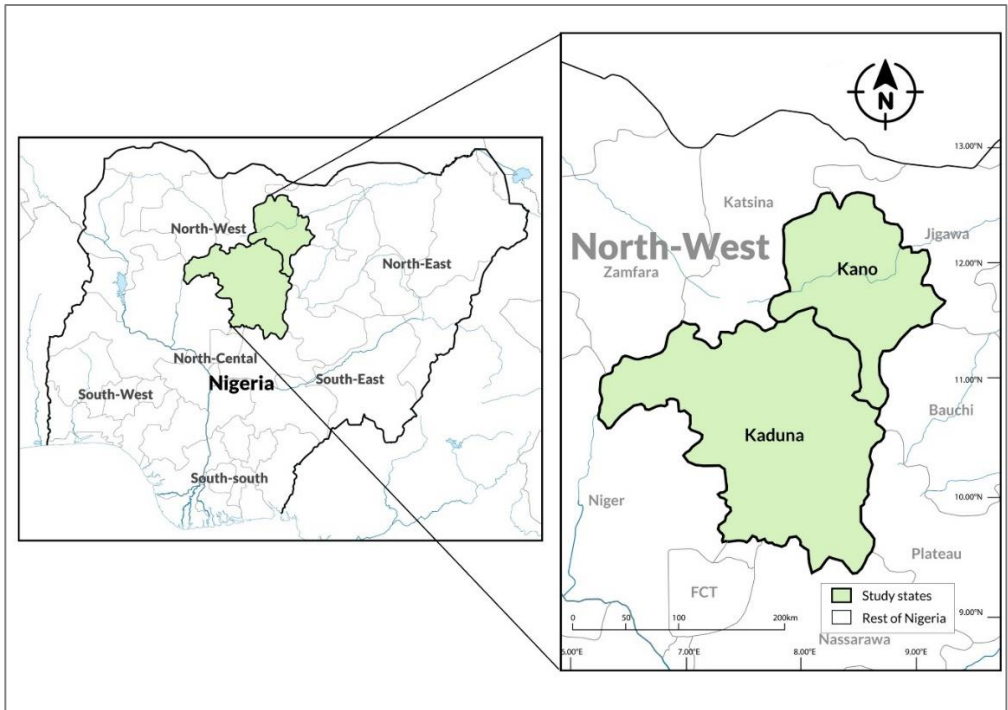

Figure 1. Map of Nigeria showing the study area
Source: Adapted from National Population Census Map

The study area lies largely in the far north Sudano-Sahel of West Africa in zone of Savanna-type vegetation belt generally classified as semi-arid and lies between Latitudes 12° and 14° N and Longitudes 5° and 7° E (NPC, 2006). Rainfall is highly seasonal and controlled by the movement of the Inter Tropical continuity (ITD) (Emeribe, 2017). The area is characterized by average annual rainfall ranging from 500mm (in the northeastern part) to 1000 mm (in the southern sub-area), but it is unreliable in many parts (Mortimore, 2001). It has a prolonged dry season (7 months) and average daily temperature ranges from $30^o - 40^oC$ (Imo and Ikpenyong, 2011). The vegetation in the area is distinguished by large expanse of grasslands with widely spaced trees of varying heights and diversity (Mustapha and Salisu, 2018). Agriculture is the main economic activity of the area (Ahmed, 2013). Major crops grown include cereals (rice, millet, sorghum, maize), beans, while groundnut and sesame are considered minors (USAID, 2007).

3.2. Data Collection and Sampling Procedure

Primary data was used for the study. The data was collected from the sample of two hundred and forty (240) households from Kaduna and Kano States (Figure 1) through interview by enumerators using Open Data Kit (ODK) application programme installed on android phones, and data was collected for both before, from 2018-2019 and during Covid-19 era in 2020 through structured questionnaire. A multistage sampling procedure was adopted for the study. The first stage involved purposive selection of Kaduna and Kano states from the Northwest region because (i) they are the two biggest economies in the region and (ii) according to Nigeria Centre for Disease Control, NCDC (2020) report, the duo have by far the highest numbers of COVID-19 infection in the region. Then, two Local Government Areas (LGAs) from each state Kaduna and Kano were selected randomly. For Kano state, Fagge and Taurani LGAs were selected while for Kaduna state, Kaduna North and Zaria LGAs were selected. Then, two urban communities from each LGA were selected randomly through balloting system, and then, one sub-community further randomly selected from each of these urban communities. This puts the total LGAs selected at four (two from each state) and eight sub-communities (two from each LGA). Finally, the list of household heads in each community was compiled with combine assistance of ward counselors, district heads and notable community members and 50% of sample frame was randomly selected in each community and this totals to 240 households (Table 1).

Table 1. Distribution of sampling procedure to select urban households in northwest, Nigeria

State	LGA	Urban sub-communities	Sample Frame	Sample Size
Kano	Fagge	Kurna	58	29
		Kwakwaci	66	33
	Taurani	Darmawa	64	32
		Daurawa	58	29
Kaduna	Kaduna North	Badarawa	60	30
		Hadija road	56	28
	Zaria	Liyin Jibga	58	29
		Liyin Wawa	60	30
2	4	8	480	240

Source: Kano and Kaduna States Agricultural Development Programme (ADP)

3.3. Analytical Technique

Price trend analysis was used to achieve the price variation of some selected cereals before and during Covid-19 pandemic among urban households. This was achieved with aid of graph and t-test to observe if there is significant difference between price of selected crop before and during Covid 19 pandemic. Household Dietary Diversity Score (HDDS) and random-effect Probit model were used to estimate the effects of Covid-19 induced spike in food prices on urban households' food security. Household dietary diversity score (HDDS) was measured by summing the number of foods or food groups consumed over a reference period (Magaji et al.,

2020; HDDS, 2006). Twelve (12) food groups included in the HDDS by HDDS (2006) and recommended by FAO, (2007, 2010) were used.

Thus, modelling household food security as:

$$FS = (A + B + C + D + E + F + G + H + I + J + K + L) \dots\dots\dots\dots\dots\dots\dots\dots\dots.(1)$$

Where FS = household food security and A-L represent the 12 food groups.

Each food group is assigned a score of 1 (if consumed) or 0 (if not consumed). The household score will range from 0-12 and is equal to the total number of food groups consumed by the household. The average household dietary diversity score for the population of study can be calculated as: Sum (HDDS) divided by total number of households surveyed.

The regression equation for the fixed effects model was written as:

$$y_{it} = \beta_1 x_{it} + \alpha_i + \mu_{it} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

Where:

α_i (i=1….n) is the unknown intercept for each entity (n entity-specific intercepts); y_{it} is the dependent variable. Where i = entity and t = time; x_{it} represents the independent variable; β_1 is the coefficient of the independent variable; and u_{it} is the error term.

The equation for the fixed effects model using binary model becomes:

$$y_{it} = \beta_0 + \beta_1 x_{1it} \dots + \beta_k x_{kit} + \gamma_2 \varepsilon_2 \dots + \gamma_n \varepsilon_n + \mu_{it} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. \dots\dots\dots. (3)$$

Where;
y_{it} = the dependent variable (DV); i = entity, while t = time;
x_{kit} = independent variables (IV); β_k is the coefficient for the IVs; μ_{it} is error term; ε_n is β_k is the coefficient for IVs; μ_{it} is the error term and ε_n is the entity n.
Being binary (dummies), you have n-1 entities included in the model and y_i is the coefficient for the binary repressors (entities).

Including time effect to the entity effects model, we have a time and entity fixed effects regression model shown below:

$$y_{it} = \beta_0 + \beta_1 x_{1it} \dots + \beta_k x_{kit} + \gamma_2 \varepsilon_2 \dots + \gamma_n \varepsilon_n + \delta_2 T_2 \dots\dots\dots + \delta_t T_t + \mu_{it} \dots\dots\dots\dots\dots. (4)$$

Where:

y_{it} is the dependent variable (DV) where i = entity and t = time; x_{kit} represents independent variables (IV); β_k is the coefficient for the IVs; μ_{it} is the error term; ε_n is the entity n. Since they are binary (dummies) you have n-1 entities included in the model; γ_2 is the coefficient for the binary regressors (entities); T_t is time as binary variable (dummy), so we have t-1 time periods; and δ_t is the coefficient for the binary time regressors.

The implicit function for the fixed-effect regression is given below:

$Y = \beta_0 + \beta_1 X_{12020} + \beta_2 X_{22020} + \beta_3 X_{32020} + \beta_4 X_{42020} + \beta_5 X_{52020} + \beta_6 X_{62020} + \beta_1 X_{12019} + \beta_2 X_{22019} + \beta_3 X_{32019} + \beta_4 X_{42019} + \beta_5 X_{52019} + \beta_6 X_{62019} + \beta_1 X_{12018} + \beta_2 X_{22018} + \beta_3 X_{32018} + \beta_4 X_{42018} + \beta_5 X_{52018} + \beta_6 X_{62018} + \mu$

Where:

Y= Food security levels of the households (ranges from 0-12); X_1= Ln price (Naira, ₦); X_2= Ln age (years); X_3= Household size (persons); X_4= COVID loan (₦); X_5= Years of Education (years)

X_6= Ln Income (₦) and μ = Error term.

4. RESULTS AND DISCUSSION

4.1. Description of Variables used in Fixed Effect Regression Model

Quantitative variables used for the fixed effect regression are captured in Table 2. The minimum price for rice was ₦220, maximum was ₦418 and average price was ₦283.This shows a wide margin of price variation before COVID-19 and during COVID-19. The household size ranged from a minimum of 1 to a maximum of 40 persons per household with an average of 7 persons per household. This shows a relatively large average family size, an indication of more food to be food secure. The age of household heads ranged from a minimum of 27 years to a maximum of 80 years, the average age was 45 years. This is an indication that the household heads are in their active age and are capable of energetic activities to provide for their households. Also, minimum COVID-19 loan obtained was ₦170,000, maximum was ₦800,000 and the average was ₦428,833. The minimum years of education was 0, the maximum was 20 years and the average years of education was 10 years, indicating that on the average the household heads had secondary school education. Household income had a minimum value of ₦30,000 and a maximum of ₦330,000 per month while average household income stood at ₦92,225. This gives a picture that the on the average households have fairly enough income to meet their basic food demand.

Table 2. Descriptive statistics of variables used for Fixed Effect Regression Model

Variables	Unit	Mean±Sdev	Min	Max	a-priori
Quantitative variable					
Price	Naira (₦)	282±82	90	418	+
Age	Years	45.4±8.7	27	80	+
Household size	Persons	7.0±4.5	1	40	+
Amount of Covid loan	Naira (₦)	428,833±121,766	170,000	800,000	±
Years of education	Years	10±6	0	20	±
Income	Naira (₦)	95,225±61,292	30,000	330,000	±
Categorical variable	**Dominant**	**Indicator (%)**			
Sex	Male	97.92			
Marital status	Single	96.72			
Occupation type	Trading	42.92			

Access to Covid 19 loan	No access	87.5

Source: Data Analysis from Survey Data (2021)

4.2. Test of Hypothesis i

H_O - *there is no significant difference in the prices of the selected commodities before and during COVID-19 pandemic*.

A two-tailed Z test was used to test the above hypotheses and the result displayed in Table 3 below.

From the Z test analysis, the calculated absolute Z values (14.38, 6.26, 4.88 and 2.98 respectively for rice, maize sorghum and millet) were greater than their critical two-tail Z values. Therefore, the null hypothesis stating that there is no significant difference in the prices of the selected commodities before and during COVID-19 pandemic was rejected.

Table 3. z-test for hypothesis i

	Rice (₦)		Maize (₦)		Sorghum (₦)		Millet (₦)	
	Bv	Dv	Bv	Dv	Bv	Dv	Bv	Dv
Mean	225.65	372.21	96.53	190.25	91.65	171.36	89.47	162.62
Known Variance	0.72	1.457	0.82	1.235	0.925	3.725	0.789	2.625
Observations	240	240	240	240	240	240	240	240
Hypo Mean Diff	0		0		0		0	
Z	14.386		6.268		4.875		2.985	
P(Z<=z) one-tail	0		0		0		0	
z Critical one-tail	1.644		1.644		1.644		1.644	
P(Z<=z) two-tail	0		0		0		0	
z Critical two-tail	1.959		1.959		1.959		1.959	

Bv = Before COVID-19 outbreak and Dv = During COVID-19 outbreak
Source: Data Analysis from Survey Data (2021)

4.3. Price Trend of Selected Cereals: Rice, Maize, Sorghum and Millet

The behaviours of the prices of rice, maize, sorghum and millet are captured in the trend lines depict in Figure 2. Secondary data from National Agricultural Extension and Research Liaison Services (NAERLS) collected on weekly basis from 2018 to 2020 were used.

The result of price trend in 2018 revealed that price of rice fluctuated slightly with 1.4% increase in the price in Q1 to 1.8% increase in the price in Q4. In Q1 of 2019, there was a slight decrease in the price by 0.88%, then increased a little by 0.89% in Q2 and slightly decreased again by 0.44% in Q3. However, the result showed a slight rise in the price in the last quarter of 2019, Q4. A very sharp and significant upward spike (62%) in the price of rice was noticed in Q1 of 2020. This upward movement continued into Q2, and then became relatively stable in Q3. This period of sharp upward movement of price translates to the early periods of economic lockdown, which followed periods of border closure by the federal government of Nigeria that was already prompting price rise in the country. However, from Q3 to Q4, only a 2.45%

increase was noticed as the economy was at this time fully reopened for economic activities and this is harvesting period for the agricultural commodities.

The trend line of maize witnessed similar movements like that of rice. From Q1 of 2018 through to early part of Q1 of 2020 only slight price fluctuations of maize was witnessed (Figure 2). But from later part of Q1 to a deeper part of Q2 of 2020. The result showed a drastic and steep upward movement of maize price by 117%. This period falls within the time of economic lockdown of the country, which triggered this unprecedented spike in the price of maize in the country. In Q3 and Q4, although, price remained high but rising just slightly (by 5.95% and 2.04%). This could translate to the regular agricultural commodity price fluctuations experienced during the main season (glut) and the high prices during the off-season (Abokyi et al., 2020).

Sorghum and millet price trends from the above result are not too different from that of maize. The duo followed similar pattern, except majorly for the percentage rise in the prices of the commodities between Q1 and Q2 of 2020 as the other intermittent rise and fall in the prices of the two commodities represent the usual fluctuations in prices of agricultural commodities which could be due to seasonality, change in demand and supply, speculative activities of middlemen among other factors. However, there was a spike in their prices in-between Q1 of 2020 and Q2 of 2020. While the price of sorghum rose by 73% with this period, millet rose from ₦110/Kg by 70%. But in Q3 and Q4 of 2020 their prices remained relatively stable.
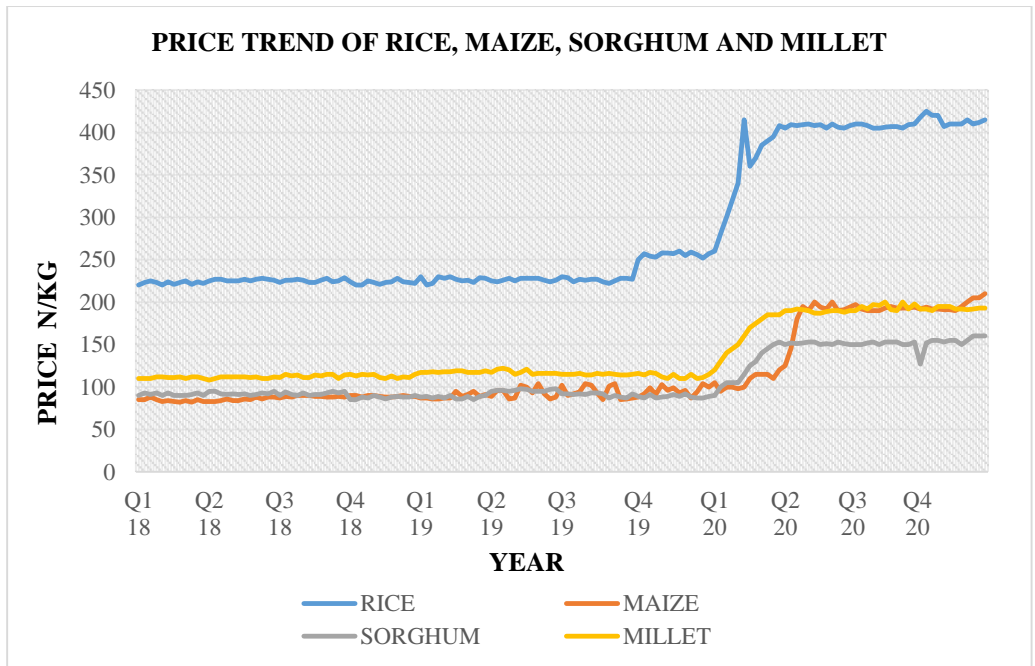

Figure 2. Price trend movements of selected cereals in the study area
Source: National Agricultural Extension and Research Liaison Services (NAERLS) Nigeria commodities Statistics Data.

The sharp spike in prices of the commodities experienced in Q1 of 2020 is obviously precipitated by a disease outbreak (COVID-19). This finding is in line with that of Lin et al.

(2020) whose study revealed increases in food prices, however, most retail commodities prices increased by less than 50% in 2020. Similarly, the study by Yu et al. (2021) conducted in China revealed no significant impact on rice and wheat flour prices, but there were significant increases in prices of cabbages and pork. Also, Cariappa et al. (2021) reported post-lockdown price spike in some commodities as follows: chickpea (4.8%), mung bean (5.2%), and tomato (78.2%), while Madzorera et al. (2021) reported increases agricultural prices and worsening dietary diversity and quality of food consumed.

4.4. Food Security Levels of Households Before and During COVID-19

The result of the food security levels of households in the study area is presented in Table 4. From the result, it was revealed that majority of the households which translate to 95% were food secure before the outbreak of COVID-19, 3% were moderately food secure while only 2% were food insecure. However, due to the effects Covid-19 had on the economy of the study area, the food secure households dropped to78%. This decreasing level of food security (from 95% to 78%) is the result of income drops and job losses experienced especially at the early phase of Covid-19 outbreak. Amare et al. (2021) summarizes the causes of declining income amidst the COVID-19 pandemic into four; fear of contracting the virus could reduce income-generating activities, government restrictions, disruptions in food systems and food supplies and disruptions in food systems and value chains.

The findings conform with the *a priori* expectations. More so, our findings are in line with the study carried out by Zidouemba et al. (2020) in Burkina Faso, whose results suggest that the severity of food insecurity is increasing among poor urban and rural households due to the effects of Covid-19. Also, our findings give similar results to that of Egger et al. (2021), whose findings revealed that COVID-19 crisis has caused widespread food insecurity and dire economic conditions even three months into the crisis in nine developing countries studied including Ghana and Kenya from Africa.

Table 4. Frequency distribution of the food security level of the households

Food security status	Before COVID-19		During COVID-19	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Secure	228	95	187	78
Moderate	8	3	45	18
Insecure	4	2	8	3
Total	240	100	240	100
Mean	**8.95**		**8.57**	
Stdev	1.6		2.79	
Minimum	0		0	
Maximum	12		12	

Source: Data Analysis from Survey Data (2021)

4.5. Test of Hypothesis ii

H_O – *there is no significant difference in the food security levels of households before and during COVID-19 pandemic.*

Like we did in hypothesis i, a two-tailed z-test was run to test the above hypotheses and the result displayed in Table 5 below. From the z-test result, the calculated absolute z value (20.07) was greater than the critical two-tail value (1.96). As such, the null hypothesis was rejected as there is significant difference in the food security levels of the households before and during COVID-19 pandemic.

Table 5. z-test for hypothesis ii

	Households Food Security Levels	
	Before COVID-19	**During COVID-19**
Mean	11.175	6.891666667
Known Variance	1.86	9.07
Observations	240	240
Hypothesized Mean Difference	0	
Z	20.0713883	
P(Z<=z) one-tail	0.00	
z Critical one-tail	1.644853627	
P(Z<=z) two-tail	0.00	
z Critical two-tail	1.959963985	

Source: Data Analysis from Survey Data (2021)

4.6. Effect of Covid-19 Induced Spike in Food Prices on Food Security of Urban Households

The equations generated to determine the effect of Covid-19 induced spike in food prices on food security of urban households was tested to confirm if there were no exact linear relationship exists among the explanatory variables (multicollinearity) and serial correlation among residues. One of the consequences of multicollinearity is that we shall be unable to isolate the separate effects of the individual explanatory variables on the dependent variables (Oladimeji et al., 2016). Therefore Farrar glauber test to check the Correlation Matrix (C M) and find a matrix of pairwise coefficient of all independent variables was used to detect multicollinearity. All pair of correlation co-efficient that is up to 0.50 and above was assumed as posing serious multicollinearity problems, in that case if existed, one of the variable was eliminated. In addition, the Durbin Watson (D. W.) statistic was used to test for the serial correlation in the residuals denote by E (Ut Ut-1). Therefore, our DW (2.8) was greater than 1.5 and was assumed to pose no serial correlation. Based on the work of Halunga et al. (2016) criteria for detecting heteroscedasticity using Breusch-Pagan test for panel data, the data for the study satisfied using fixed effect regression estimators and the estimated diagnostic results also revealed that the fixed effect regression model fits the data as the F-value, $F(6, 474) = 106.81$ and Prob. $> F = 0.000$ was statistically significant.

The results presented in Table 6 are the fixed-effects regression estimates of the causal effects of the resulting spike in food prices due to COVID-19 pandemic on food security status of

urban households in the study area. From the fixed effect regression results, price, HHS, COVID-19 loan and household income were found to have significant effects on food security status of households.

The coefficient of household size (HHS) was positive and significant at 5% confidence interval. The result shows that increasing the number of households by one person will lead to 0.02 units increase in food security. Although, this is contrary to *a priori* expectation but an explanation for this goes thus, our data showed that households with large HHS, at several instances had between 2 to 5 working adults that were very educated and whose incomes add up to give a relatively large total HH income. As such, reducing their dependency ratio and allowing them enough income to meet their food demands (Aboaba et al., 2020). Similarly, Ajaero (2017), reported in a flood study in Anambra state that larger household size was a significant predictor of food security for both MHHs and FHHs after a flood occurred. Also, Omotesho (2006), opined from his study in Kwara state that, gross farm income, total non-farm income and household size are significant determinants of rural household food security in the study area.

Table 6. Estimates of effects of COVID-19 induced spike in food prices on food security of households

Variables	Coefficients	Robust std. error	Z	P>Z
Ln price	-1.05***	0.054	-19.57	0
Ln age	-0.009	0.071	-0.13	0.894
HHS	0.02**	0.009	0.39	0.028
Covid loan	-1.40e-07**	5.80e-08	-0.42	0.02
Years of edu	-0.0001	0.00081	1.7	0.677
Ln income	0.015*	0.00872	0.63	0.09
Diagnostic analysis	106.81***			
F (6, 474)				
Prob > F	0.00			
Number of observations	**720**			
Number of groups	240			

Note: ***, **, * denote significance at 1, 5, 10 % level of probability, Ln – Natural Log
Source: Data Analysis from Survey Data (2021)

The coefficient of price was negative and statistically significant at 1%. This implies that price and food security level have an inverse relationship. The value of the price coefficient indicates that a naira increase in price will lead to a decrease in the level of food security of urban households by 1.05 units. This is to emphasize the role prices of commodities play in determining food security status of households. This finding is in line with that of Amolegbe et al. (2021) whose study opined that unexpected increase in the price of rice negatively affects household food security. In a similar study conducted by Mkhawani et al. (2016) in South Africa, they reported that majority (57%) of participants resorted to buying cheaper brands as the rising food prices worsened the level of food insecurity. According to Kay Summers (2022),

more than enough food to feed everyone on the planet is grown yearly, however, income inequality coupled with the devastating impact that COVID-19 had on economies around the world have hindered households from meeting their food needs.

The coefficient of COVID-19 loan was negative and significant at 5% with regression coefficient value of -0.134e-7. This inverse relationship between COVID-19 loan and the food security level is against the *a priori* expectation, as the COVID-19 relieve loans made available by the federal government was meant to help increase food security of households. In contrast, the result revealed that inaccessibility of the loan by households who actually needed the loan was a great bottle-neck of the scheme, as only 6.25% of the households' heads sampled benefitted from the COVID-19 loan scheme. Also, there was high level of diversion of the loan to other uses couple with poor monitoring from the government and its agencies to ensure the loan was disbursed fairly and used for the right purposes.

Finally, the coefficient of household income was positive and significant at 10% level of significance. This implies that a naira increase in the household income will increase food security level by 0.015 units. This finding conforms with the study of Babatunde and Qaim (2010), who opined that income has a positive net effect on food security and nutrition among households. Increased food insecurity results principally from the severe shock to household income (Arndt et al., 2020). Having enough income at one's disposal provides the comfort of being able to afford all food needs. This claim is further supported by the study of Rahman and Mishra (2020), whose study revealed that farmers who diversify into non-agricultural livelihoods to increase their income end up having more to spend on food expenditure, thereby improving their food security status.

5. CONCLUSION

The study examined the effects of COVID-19 induced spike in food prices on urban households' food security status in Northwest, Nigeria. The sharp spike in prices of the commodities experienced in Q1 of 2020 is obviously precipitated by a disease outbreak (COVID-19). The study proved the obvious, that spike in food prices resulting from COVID-19 pandemic caused a decline in the food security level of the households in the study area. This is a clear indication that measures introduced to curtail the spread of the Corona virus had favoured unprecedented rise in food prices. While the coefficient of price was significant with a negative relationship with the food security level of the households that of household income was positive and significant. The implication of the findings is that government should give more attention to modernisation of agricultural practices and address the frequent clashes between herders and farmers as these will go a long way in boosting agricultural outputs and reduce the prices of produce. One major advantage of this study was the access to field survey through cross sectional data and longitudinal panel data for price trend analysis from Nigerian Bureau of Statistics (NBS). However, some household heads could not quantify the Kilocalorie of food type consumed hence, HDDS approach is used to assess food security status of the urban households in this study. It is pertinent to note that the food security measurement is multidimensional approach.

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