



Demographic considerations and food security in Nigeria

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Abstract

Close to 14 million people in Nigeria, including children, are malnourished. I hypothesize that demographic considerations play an important role in food insecurity within Nigerian households. Using data from three waves of the World Bank's Living Standard Measurement Survey for Nigeria, I illustrate spatial patterns of food security in the country. Using fixed effects regressions, I also show that, at the household level, larger households have worse food security outcomes and are more likely to report being food insecure. Children from large households also suffer worse malnutrition outcomes. This relationship is significant in urban Nigeria as well, with implications for sustainable urban planning and family planning to address unmet need for contraceptives.

Keywords Food security · Child malnutrition · Spatial trends · Fertility · Nigeria

JEL Classification I15 · I18 · J13 · P25 · Q18

Introduction

The idea that a nation's population growth may have significant effects on individuals' access to food and other resources is not new and was indeed postulated by Malthus as far back as the 1800s. According to statistics from the UN Population Division (2010), by 2050, population growth will result in a doubling of the global demand for food. In sub-Saharan Africa, even if fertility rates were to decline from their current levels, the population of the region is projected to double, with attendant implications for food security.

The importance of access to food and food security has been emphasized by the second Sustainability Development Goal (SDG) which aims to end hunger and achieve food security by 2030. According to the widely accepted Food and Agriculture Organization of the United Nations (1996) definition, food security is said to exist when all people at all times have access to sufficient food to meet their dietary needs for a productive and healthy life. The FAO also identifies population growth as a critical determinant of food security (FAO 2009, 2013). It is therefore not surprising that with the observed large increases in the country's population, Nigeria faces a crisis in terms of access to food

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and general food availability. Nigeria's population is approximately 198 million people, making it the most populous country in Africa and the seventh most populous country in the world. Currently, according to statistics from the Intelligence Unit of The Economist, Nigeria is ranked at 38 out of 100 according to its food security status. This is illustrated in Fig. 1. This low-rank status is indicative of the challenges that the country experiences with food security.

Despite Nigeria having achieved a reduction in undernourishment of the population by more than half, from 19.3% in 1990 to 8.5% in 2010 to 2012, the number of people who are undernourished increased from approximately 10 million people in 2010 to about 14 million by 2016 (FAO 2017), with more severe conditions observed in the conflict-prone north-eastern zone of the country. In addition to differences by geographical zones, there are also rural/urban, and cultural variations in food security across the country. Nigeria's policies to address its food insecurity has mainly been supply-driven and a number of local and national programmes and policies are aimed at increasing agricultural production (e.g., National Policy on Food and Nutrition in early 2001; Zero Hunger by 2030, 2016 National Plan of Action on Food and Nutrition, FAO emergency programmes, Global Food Security Strategy, etc.). Given the low uptake of contraceptives in the country (e.g., only 1-in-10 married woman uses a contraceptive method in Nigeria, according to the 2013 Nigerian Demographic Health Survey), a link between fertility and food security presents the opportunity for the use of demand-side strategies to the problem of food deficit in the country.

The study is also justifiably urban-focused. According to the 2014 World Urbanization Prospects report, by 2050, more than 70% of the world's population will be living in urban areas, implying that all of the expected population growth will occur in urban regions. According to UN DESA (2018), together, India, China and Nigeria will account for 35% of the projected growth of the world's urban population between 2018 and 2050, and Nigeria would have added close to 190 million more people to its urban population. In Nigeria, the National Population Commission puts the average annual urban growth rate at 6.5%. The continued expansion in urbanization, from 34.8% in 2000 to 49.5% by 2017, also has implications for food availability and affordability. The implication of an expanding urban population is that residents must increasingly depend on their available incomes, giving the limited opportunities for farming, in order to ensure their access to food (FAO 2010). The situation of generally low incomes, combined with rising food prices, has implications for the food security status of urban households. The eleventh sustainability goal aims at, among other things, the creation of sustainable cities. A city is unlikely to be sustainable if it is food insecure. According to the Akerele (2015), poor urban households can spend up to 60% of their budgets on food alone. In Nigeria, households spend about 56.6% of their total household budgets on food. A more recent estimate by the Bank of Nigeria puts the estimate at about 73%, with likely negative implications for human capital investments. Smaller family sizes, particularly in urban areas may be key to solving food shortage problems. Despite cities in Nigeria housing some of the largest populations in the world, there is currently no urban policy that links smaller family sizes with food security.

The research questions explored in this paper are as follows:

- What is the effect of fertility on individual- and household-level food security in Nigeria?
- Is the effect differentiated for urban residents?

The research contributes to existing knowledge in a number of different ways.

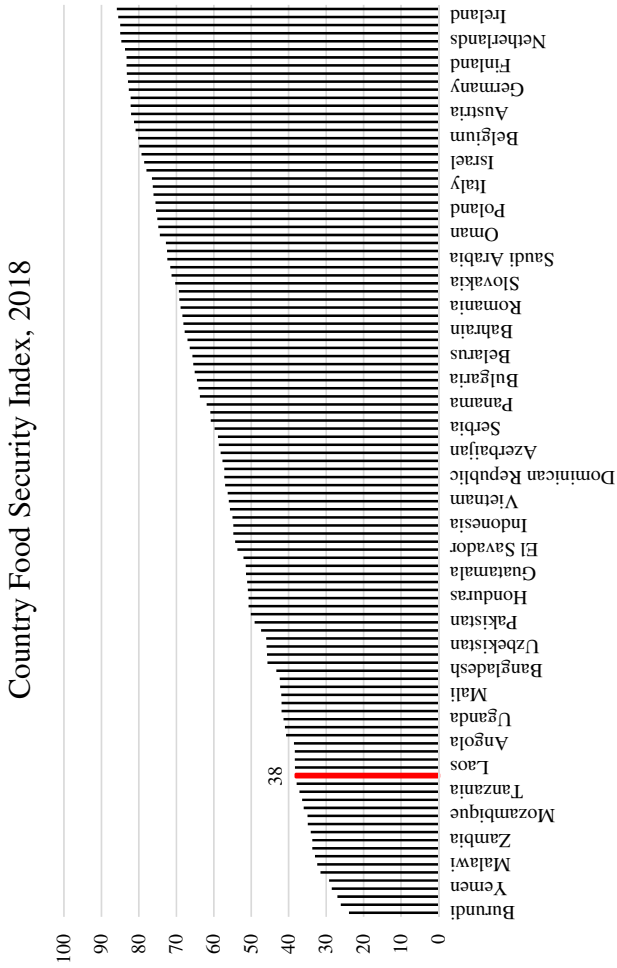


Fig. 1 Global food security statistics

First, distinct from many other existing studies, this research uses nationally representative data. Second, given the growth of cities around the world, particularly in Nigeria, the study focuses on food security implications on urban areas in the country. Third, the use of panel data allows for the analyses of dynamic relationships and also controls for potentially unobserved, unmeasured variables. Fourth, the use of different food security and fertility measures provides an adequate test of the robustness of results.

The remainder of the paper is structured as follows: Sect. 2 briefly reviews the existing literature on fertility and food security, with some focus on the chosen measures for food security; Section 3 presents information on the data used for the analyses and the empirical techniques adopted. Section 4 summarizes the main results, following the empirical analyses, while Sect. 5 discusses and situates the research in the relevant context. Section 5 concludes with relevant policy implications and applications of the research.

Fertility and food security

A number of different studies have examined determinants of food security in both developed and developing country contexts. These studies have used varied proxies for food security and different measures of fertility. Indeed, given the multidimensional nature of food security, there is no single indicator that is considered sufficient to measure all aspects of food insecurity and as such, there is currently no gold standard tool in existence.

A popular measure of food security that has been adopted in the literature is Dietary Diversity Scores, as developed by Wiesmann et al. (2009). Dietary diversity is defined as the number of unique foods or food groups consumed over a given period. This tool has been considered to be a good proxy for measuring dietary quality and nutrient adequacy in low-income countries (Hatloy et al. 2000). The evidence for the effects of household size on diversity scores seems to suggest a positive relationship. Workicho et al. (2016) examined predictors of household dietary diversity in Ethiopia using a representative sample and found that households with greater than four members were associated with better dietary quality and nutritional scores. In this instance, and in a similar study on Tanzania (Kamuzora and Mkanta 2000), larger households were associated with a higher number of working members who could contribute to the household through greater provision of farm labor or through non-farm incomes. Powell et al. (2017) conducted qualitative surveys on small-scale agricultural communities in Tanzania and found that while a number of respondents noted large family sizes as a potential obstacle to achieving dietary diversity and food security, other survey respondents argued that larger family sizes may increase dietary diversity. This is because it is more difficult to get enough of any one type of food to feed a large family.

Another measure of food security that has been adopted in existing works is the Coping Strategies Index, developed by Maxwell (1996). This is a more direct measure of food security, compared to dietary diversity scores, and is designed to candidly measure core behaviors and experiences related to food sufficiency or food insecurity. Shariff and Khor (2008) examine the determinants of food security among 200 households in rural Malaysia and found that larger households had to adopt more coping strategies in response to food deficits. Higher fertility was noted to be a risk factor for food insecurity. Farzana et al. (2017) and Olayemi (2012) also found that in Bangladesh and Nigeria, respectively, larger households were more food insecure compared to those with small numbers of members. The use of a single measure of food security was emphasized by the researchers themselves

as a serious limitation of their study, given that reduced coping strategy findings may be context- or setting-specific. This indicator should therefore be validated against other indicators such as food consumption (household, individual), poverty measures (income and expenditure) and individual health and nutritional status—a caution that is repeated by several other researchers. The present study therefore employs the use of direct *and* indirect, quantitative *and* qualitative measure of food security in the analyses. These are detailed in the next section.

Dietary diversity and Household coping strategies have been classified as more qualitative measures of food security; few studies have used quantitative measures in assessing the predictors of food security. Using nationally representative data on South Africa and constructing food security indices from information on food expenditures, Rose and Charlton (2002) found that food insecurity increased with increasing household size. Other studies have proxied food security by caloric intake (e.g., Tefera and Tefera 2014) and have found similar relationships.

Despite the prevalence of studies on household food security, fewer studies have attempted to examine food security using individual-level measures. Indeed, food security is best considered individually, since different members of the same households can experience different outcomes based on gender, age, culture or other factors (Owoo 2018). Saaka et al. (2017) examined determinants of dietary diversity of children resident in rural parts of Northern Ghana. Dietary diversity scores (DDS) were calculated by summing up the different number of food groups consumed by a child 6–36 months of age as reported over a 24-h recall period. Findings indicated that children resident in larger households were more likely to meet minimum dietary diversity standards, possibly because adults could be contributing to food access in the households through their own production or through purchases. A limitation of this study is however the recall bias in food intake. The present study uses children's anthropometric measures as a more robust proxy for child nutritional status. Although other researchers have found similar results as Saaka et al. (2017) (e.g., M'Kaibi et al. (2016); Thiele and Weiss (2003)), other studies have reached a different conclusion. Using Demographic and Health Survey data for 16 countries and children's anthropometric measurements as a proxy for their food security status, Desai (1992) compared the food security status of children in large families with the status of those from smaller ones using results from country-specific regressions of food security on family size and a variety of socioeconomic indicators. Findings indicated that in the short run, children incurred adverse nutritional effects when they belonged to larger households. Kucera and Mcintosh (1991) found that among children aged 4–6 years old in the United States, children from small families were at lower nutritional risk than those from medium or large families. Additionally, children from medium families were at lower nutritional risk than those from large families. Other studies have found similar evidence of a negative relationship between household size and children's nutritional outcomes (Pryer et al. 2002; Ahsan et al. 2017). In their study on rural communities in Kwara State, Nigeria, Fadare et al. (2019) find that larger household are associated with higher odds of stunted children.

Data and methods

The analysis uses data from three (3) waves of the World Bank's Living Standards Measurement Survey (LSMS) for Nigeria—2011, 2013 and 2016. This is a nationally representative dataset of 5000 households in Nigeria with approximately 1500 urban households

in each wave. Attrition was present between each wave of data. The majority of the reduction in the sample was due to the security situation in the North-East Zone. A total of 14 enumeration areas could not be visited in Borno and Yobe states as a result, leading to the loss of 139 households from the sample. Other reasons for attrition were that households refused to be interviewed, were untraceable, or members had died since Wave 1 (Nigerian Bureau of Statistics 2016).

The survey comprises three main components: household, agriculture and community modules. The present study draws data from each of these components, but focuses primarily on the household and agriculture modules, which includes information on demographics, education, health, food security, and economic shocks, among others. The data also includes detailed information on food security for the post-harvest period, which allows the computation of various quantitative and qualitative indices. Dependent and explanatory variables are discussed below.

Methods

Panel data regression analyses are employed and described in greater detail below.

Household-level analyses

The fixed effects model may be specified as follows:

$$FoodSecurity_{h,t} = \alpha_0 + \beta_h Fert_{h,t} + \rho_h X_{h,t} + \theta_t T_t + \epsilon_{h,t} \quad (1)$$

where $FoodSecurity_{h,t}$ refers to the various food security measures constructed at the household level (i.e., RCSI, FCS, HHS, etc.). $X_{h,t}$ refers to the index of controls as presented in Table 1. $Fert_{h,t}$ refers to the measures of fertility to be used in the analyses (see Table 1); T_t is an index of year and geographical zone controls. Given the dichotomous nature of some food security measures (i.e., FCS), a probit fixed effects model will be estimated, instead. Household-level analyses are disaggregated by rural/urban residence.

Child-level analyses

A household fixed effects model is run to explore within-variations of fertility on child health and nutrition outcomes at the household level. The model may be specified as follows:

$$Nutr_{i,h,t} = \beta_0 + \pi_{i,h} Fert_{i,h,t} + \sigma_{i,h} M_{i,h,t} + \nu_{i,h} F_{i,h,t} + \psi_{i,h} C_{i,h,t} + \rho_h X_{h,t} + \mu_h + \epsilon_{i,h,t} \quad (2)$$

where $Nutr_{i,h,t}$ in (2) above refers to the health status of the i th child (HAZ or WHZ). $M_{i,h,t}$ refers to the characteristics of the i th child's mother (age, work and education status); $F_{i,h,t}$ refers to the characteristics of the i th child's father (age, work and education status); $C_{i,h,t}$ refers to personal characteristics of the i th child (i.e., age, sex, birth order). $Fert_{i,h,t}$ is as fined in (1) above and μ_h is the household fixed effect. $X_{h,t}$ refers to other household characteristics. $\epsilon_{i,h,t}$ is the error term. The regressions are further presented for urban households—as a result of the fewer observations and degrees of freedom issues, simple pooled OLS regressions are run for the urban sample, without household fixed effects as employed in the full sample.

Table 1 Household-level characteristics, NGHHS, 2016 (Wave 3)

	Full sample		Rural		Urban		T tests		
	Mean	SD	Mean	SD	Mean	SD	Rural–Urban	T statistics	
<i>Food security measures</i>									
Reduced Coping Strategies Index (0–56)	3.946	6.56	3.714	6.17	4.28	7.09	–0.231	(–1.13)	
Household Hunger Scale (adapted; freq. elicited weekly)	0.159	0.62	0.14	0.56	0.185	0.69	–0.0380**	(–1.98)	
Self-reported food shortage in the past year	0.196	0.4	0.17	0.38	0.235	0.42	–0.0473***	(–3.78)	
Per capita food expenditures	43,256.15	85,689.3	35,347.7	68,380.3	54,663.4	104,760.2	–21,232.4***	(–8.11)	
Food consumption scores	53.71	19.43	49.836	18.83	59.296	18.91	–8.785***	(–14.44)	
<i>Fertility measures (main explanatory variable)</i>									
# Own children	3.973	2.97	4.322	3.08	3.469	2.71	0.798***	(8.33)	
# Household members <5 years old	0.629	0.93	0.719	0.99	0.498	0.83	0.186***	(6.19)	
# Household members <15 years old	2.281	2.22	2.564	2.33	1.872	1.97	0.649***	(9.15)	
Dependency ratio-(under 15 + aged)/all members	0.44	0.27	0.462	0.26	0.409	0.28	0.0380***	(4.57)	
Household size	5.522	3.19	5.946	3.35	4.911	2.84	0.973***	(9.44)	
<i>Other explanatory variables</i>									
Gender of household head	0.789	0.41	0.808	0.39	0.762	0.43	0.0592***	(4.65)	
Age of household head	53.085	14.62	53.319	14.71	52.748	14.48	–0.0742	(–0.16)	
Household head is employed (yes = 1)	0.815	0.39	0.825	0.38	0.801	0.4	0.0159	(1.30)	
<i>Education of household head</i>									
No education	0.109	0.31	0.165	0.37	0.038	0.19	0.103***	(9.84)	
Basic education qualification	0.282	0.45	0.332	0.47	0.219	0.41	0.115***	(7.72)	
Secondary school qualification	0.36	0.48	0.32	0.47	0.411	0.49	–0.0605***	(–3.81)	
Post-secondary education qualification	0.248	0.43	0.182	0.39	0.332	0.47	–0.157***	(–11.22)	
household head is Muslim (yes = 1)	0.434	0.5	0.464	0.5	0.391	0.49	0.0345**	(2.20)	
Urban locality	0.409	0.49	–	–	–	–	–	–	
Poorest wealth quintile	0.163	0.37	0.258	0.44	0.024	0.15	0.248***	(20.33)	
Poorer wealth quintile	0.178	0.38	0.256	0.44	0.063	0.24	0.176***	(14.12)	

Table 1 (continued)

	Full sample		Rural		Urban		T tests	
	Mean	SD	Mean	SD	Mean	SD	Rural–Urban	T statistics
	Middle wealth quintile	0.195	0.4	0.215	0.41	0.165	0.37	0.0242
Richer wealth quintile	0.225	0.42	0.158	0.36	0.324	0.47	-0.150***	(-11.92)
Richest wealth quintile	0.239	0.43	0.114	0.32	0.424	0.49	-0.298***	(-25.00)
Agricultural livelihood	0.551	0.5	0.804	0.4	0.188	0.39	0.595***	(47.69)
Tropical livestock units (TLU)	1.955	8.4	2.168	8.89	0.825	4.88	1.252***	(2.82)
Idiosyncratic shock	1	0	1	0	1	0	0	-
North central zone	0.138	0.34	0.159	0.37	0.107	0.31	0.0298**	(2.49)
North east zone	0.101	0.3	0.144	0.35	0.039	0.19	0.104***	(9.57)
North west zone	0.207	0.41	0.27	0.44	0.116	0.32	0.123***	(9.92)
South east zone	0.142	0.35	0.17	0.38	0.103	0.3	0.0484***	(4.13)
South–south zone	0.16	0.37	0.163	0.37	0.157	0.36	0.00502	(0.43)
South west zone	0.251	0.43	0.094	0.29	0.478	0.5	-0.310***	(-28.34)
Observations	4579		3112		1467		4579	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Dependent variables

The combination of both quantitative and qualitative approaches as a measure of food security is a useful strategy for policy research or for proper identification of the food insecure populations (Maxwell 1998; Chung et al. 1997). To this end, this paper employs both direct and indirect measures of food security, in addition to quantitative and qualitative measures. Additionally, two levels of food security are examined in the analysis—one group focuses on *household* indicators of food security while the other centers on *individual/child-level* food security. Household measures of food security include the Reduced Coping Strategies Index (RCSI), the Food Consumption Score (FCS), the Household Hunger Scale (HHS), household food expenditures and Self-reported measures of household food security status. Individual-level food security is measured by child anthropometric measures including height-for-age and weight-for-height z-scores. Each of these groups of dependent variables is discussed in greater detail below.

Household food security indicators

The Coping Strategies Index, a *direct* and *qualitative* measure of food security developed by Maxwell (1996), looks at the behaviors exercised by households in order to cope with a food deficit. Questions about behaviors—ranging from changes in dietary patterns to alternative strategies for obtaining food—and their frequency are asked of households, and the resulting scores range from 0 to 108; the higher the index score, the more food insecure the household is. Four types of consumption coping strategies are commonly employed. First, households may change their diet by, for instance, switching food consumption from preferred foods to cheaper, less preferred substitutes. Second, households can attempt to increase their food supplies by employing short-term strategies that are not sustainable over a long period; these include borrowing or purchasing on credit. Third, when faced with food shortages, households can try to reduce the number of people that they have to feed by sending some of them elsewhere such as neighbors' houses to eat. Finally, what is most common is that households can attempt to manage the shortfall by rationing the food available to the household (e.g., cutting portion size or the number of meals, favoring certain household members, such as children, over others, or skipping whole days without eating). The different strategies are “weighted” differently, depending on how severe they are considered to be by the people who rely on them. For instance, a coping strategy like “restricting consumption by adults in order for small children to eat” is weighted higher than “relying on less preferred foods.” The frequency answer is then multiplied by a weight that reflects the severity of individual behaviors. The basic idea of this index is to measure the frequency of the coping behaviors described above in terms of how often they are used; and the severity of the strategies adopted. Information on the frequency and severity is then combined in a single score, the Coping Strategies Index, which is an indicator of the household's food security status.

The Household Hunger Scale is a food deprivation index based on the premise that the experience of household food deprivation causes predictable reactions that can be captured through a survey and summarized in a scale. This is a *direct* and *qualitative* measure of food security. The HHS is a measure of more extreme food security and asks questions about whether household members go a whole day and night without eating; have no food of any kind in the house; go to sleep hungry at night because there is

insufficient food in the house. The HHS also focuses solely on food quantity, and not the dietary diversity or quality of food.

The Food Consumption Score (FCS) on the other hand is a measure of dietary diversity. This is an *indirect* and *qualitative* measure of food security. The Index was developed by the World Food Programme (Wiesmann et al. 2009; WFP 2009) and asks about frequency of consumption over a period of time for cereals and tubers, pulses, vegetables, fruit, meat and fish, milk, sugar, and oil. The scale ranges from 0 to 64, with 0–12 considered poor food consumption, 12.5–20 considered borderline food consumption, and scores above 20 considered adequate food consumption. Unlike the RCSI and HHS, higher FCS indicates improved food security.

“Self-Reported Food Insufficiency” is an indicator based on the response by the household to the question, “In the past 12 months, have you been faced with a situation when you did not have enough food to feed the household?” This is similar to other measures of food security by researchers such as Rose and Oliveira (1997) where households are classified as being food insecure if they respond that they sometimes or often do not get enough to eat. This is a *direct* and *qualitative* measure of food security.

Nominal annual per capita food expenditures are used as another measure of households’ food security status; this is an *indirect* and *quantitative* proxy for food security. This measure is preferred to the use of per capita income given the potential nonlinear relationship between income and calorie intake. Higher per capita food expenditures are indicative of higher food security (Melgar-Quinonez et al. 2006).

Individual-level food security indicators

Child anthropometric measures are used as a proxy for individual-level food security. These measures of nutritional status are collected for children less than 60 months of age. Two indicators of child nutrition are used in this study; these include the height-for-age (HAZ) and the weight-for-height (WHZ) z-scores. These are *indirect* and *quantitative* proxies for food security at the individual level.

The height-for-age (HAZ) measure is expressed as a z-score. Z-scores are calculated by standardizing a child’s height given age and sex against an international standard of well-nourished children. A z-score of -1 indicates that given age and sex, the child’s height is one standard deviation below the median child in that age/sex group. Children with z-scores below -2 are classified as stunted; with z-scores below -3 are classified as severely stunted. Height-for-age is a good long-term indicator of the nutritional status of a population because it is not markedly affected by short-term factors such as season of data collection, epidemic illnesses, acute food shortages, and recent shifts in social or economic policies. Higher HAZ scores are indicative of better child nutrition and therefore, food security.

The weight-for-height (WHZ) measure is also expressed as a z-score. Z-scores are calculated by standardizing a child’s weight given height and sex against an international standard of well-nourished children. Children with z-scores below -2 are classified as wasted; with z-scores below -3 are classified as severely wasted. This is an indicator of transitory or short-term nutritional deprivation and children may suffer thinness resulting from energy deficit and/or disease-induced poor appetite, or loss of nutrients. Higher weight-for-height z-scores are indicative of better nutrition and food security levels.

Explanatory variables and hypothesized relationships

The main explanatory variable of interest is fertility. Five (5) different measures of fertility are employed in the research. These include the total household size, the number of own-children ever born to women (excluding deceased and non-resident children); the number of all children below 5 years of age in the household; the number of all children below 15 years of age in the household; and the household dependency ratio (i.e., the ration of dependents-children and elderly to all household members). The relationship between household size and food security is inconclusive. On the one hand, larger households can lead to improved food (Workicho et al. 2016; Powell et al. 2017); while other researchers have found that it could reduce it (Farzana et al. 2017; Olayemi 2012).

A number of other explanatory variables are employed in the research. At the household level, these include the sex, age, education and employment status of household head. Female-headed households tend to be associated with worse food security outcomes by virtue of inheritance laws which limit access to agricultural land for cultivation; land tenure laws which constrain crop diversity, among others (Powell et al. 2017). Being literate is also hypothesized to be positively related with better food security (Workicho et al. 2016). Generally, households with better socioeconomic statuses (i.e., employed, wealthy, etc.) are associated with better food security outcomes (Belachew et al. 2013; FAO 2008). We include supply-side determinants as well. Access to farmlands and ownership of cattle are expected to improve dietary diversity and food security (Workicho et al. 2016), while the presence of idiosyncratic¹ shocks should reduce households' food security.

At the child/individual level, in addition to household factors like mother and father's age, parent's education, parent's employment status, religion, urban residence, presence of idiosyncratic shocks, land and livestock ownership and household wealth, other child-level characteristics are included. Child malnutrition has also been observed to increase with birth order (Black et al. 2005; Cameron and Lim 2007; Hatton and Martin 2008). Reasons for this may be biological or cultural. Biologically, children's nutritional status may decrease with increased childbearing by the mother, given the detrimental impacts that childbirth may have had on her health. Also, low birth orders have more undivided parents' attention (and resources) devoted to them in their earlier years (Hatton and Martin 2008). Culturally, older children may also be favored because in their parents' old age, the oldest child is the most likely to care for parents.

Child malnutrition generally increases with child's age (Yimer 2000; Van de Poel et al. 2007). The sex of the child is also included in the regressions to determine if parents give preferential treatment to boys versus girls or vice versa, as some of the literature demonstrates (Horton 1988; Bronte-Tinkew 1998). Urban location is included in the regression analysis. Nutrition is affected by the prevalence of disease and poor health and given the presence of health facilities in urban areas, there may be a positive relationship between child nutrition and urban areas. However, the lower food prices in rural areas may lead to a positive relationship between child nutrition and rural location.

¹ These include the following shocks; death/disability/illness/departure of a working adult, death of someone who sends remittances, loss of an important contact, job loss, non-farm business failure, theft of crops, cash or livestock, destruction of harvest, destruction of dwelling.

Descriptive statistics

The tables below provide descriptive statistics of study variables at both the household- and individual-level for the most recent wave of the NGHS survey. The data in each table is disaggregated by rural/urban residence and survey weights are applied in the calculations. This section also includes a description of food security trends in Nigeria between 2011 and 2016, in addition to visual depictions of the distribution of food security across the country.

Summary statistics

Table 1 presents summary statistics for analysis at the household level. Various food security proxies are presented for both rural and urban Nigeria. Food insecurity is higher in urban areas, compared to rural areas, using the reduced coping strategies index, the Household hunger scale and household members' own reported assessment. The seeming inconsistency of low-income households reporting better food security than higher-income households has been reported (Rose 1999; Olson et al. 1997). An explanation for this is that the cultural perceptions of food sufficiency may differ between rural and urban households. A meal consisting of rice with eggs may be adequate for rural households but not for urban counterparts, as food items like eggs may be considered as side dishes only. Therefore, given the same amount and types of foods, it is more likely for the urban households to report food insecurity compared to the rural households. The situation is reversed however, using annual nominal per capita food expenditures and dietary diversity measurements, where food insecurity appears to be higher in rural areas.

With respect to the various fertility measures adopted in the study, household size, number of own children and dependency ratios appear to be significantly higher in rural, compared to urban, households. Majority of household heads are male, and heads are, on average, about 53 years of age. Over 80% of household heads in rural and urban areas are employed and household heads in urban areas have higher educational attainment and better wealth status, compared to heads in rural households. Rural household heads however possess more livestock and have greater access to agricultural land, compared to urban household heads. With the exception of households in the South West zone, most households in other regions are based in rural areas.

Table 2 presents summary statistics for analysis at the individual level. Anthropometric measures indicate that while children in urban areas are healthier and have better food security in the long run, children in rural areas have higher weight-for-height scores, indicative of better short-term nutritional status and food security. Information is provided on the characteristics of children's parents—Mothers of children in rural areas are generally older and less educated.

Although over 93% of fathers are employed, significantly more fathers are employed in urban, compared to rural, areas. Similar to the situation observed among mothers, fathers in urban areas are more highly educated than fathers in rural areas. Anthropometric measures are available for only children below 60 months of age. The average child in the sample is about 2 years and is the fourth born child. There is an equal proportion of girls and boys in the sample.

Table 2 Individual-level characteristics, NGHS, 2016 (Wave 3)

	Full sample		Rural		Urban		T tests	
	Mean	SD	Mean	SD	Mean	SD	Rural–urban	T statistics
Length/height-for-age Z-score	−1.294	1.82	−1.372	1.93	−1.149	1.57	−0.191*	(−1.81)
Weight-for-height Z-score	−0.176	1.52	−0.126	1.6	−0.268	1.36	0.158*	(1.78)
<i>Characteristics of mother</i>								
Age (years)	37.657	11.16	38.196	12.03	36.637	9.24	2.185**	(3.21)
Employed	0.667	0.47	0.67	0.47	0.661	0.47	0.0217	(0.80)
No education	0.243	0.43	0.35	0.48	0.099	0.3	0.205***	(7.40)
Basic education	0.416	0.49	0.411	0.49	0.423	0.49	0.0173	(0.52)
Secondary education	0.281	0.45	0.206	0.4	0.382	0.49	−0.152***	(−5.19)
Post-secondary education	0.115	0.32	0.092	0.29	0.147	0.35	−0.0684***	(−3.25)
<i>Characteristics of father</i>								
Age (years)	46.253	10.99	46.71	11.24	45.361	10.46	0.783	(1.15)
Employed	0.931	0.25	0.913	0.28	0.967	0.18	−0.0569***	(−3.51)
No education	0.197	0.4	0.278	0.45	0.075	0.26	0.170***	(6.74)
Basic education	0.329	0.47	0.331	0.47	0.325	0.47	0.0148	(0.48)
Secondary education	0.285	0.45	0.215	0.41	0.392	0.49	−0.109***	(−3.72)
Post-secondary education	0.199	0.4	0.189	0.39	0.213	0.41	−0.0672*	(−2.56)
<i>Characteristics of child</i>								
Age	2.31	1.42	2.242	1.42	2.437	1.42	−0.107	(−1.40)
Gender (male = 1)	0.51	0.5	0.506	0.5	0.518	0.5	−0.0207	(−0.77)
Birth order	4.662	2.56	4.866	2.48	4.28	2.65	0.524***	(3.45)
Observations	1667		1187		480		1667	

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Trends in food security in Nigeria, 2011–2016

Figure 2a–e presents trend analysis of food security measures in Nigeria between 2011 and 2016, using the three waves of the Nigerian General Household Survey. Separate graphs are presented for urban households. With respect to coping strategies in Fig. 2a, food security has been worsening between 2011 and 2016, with urban households having to adopt more strategies to cope with food deficits. In Fig. 2b extreme food insecurity has been decreasing consistently over time, although urban households show relatively higher levels of insecurity. In Fig. 2c, while food insufficiency has fallen between 2011 and 2016 in the general population, the percentage of households in urban Nigeria who report food insufficiency increased between 2013 and 2016.

Food security is better in urban areas, according to dietary diversity scores and per capita food expenditure. In Fig. 2d, dietary diversity has been improving over time in Nigeria, and is particularly higher in urban Nigeria. Food expenditures have also been increasing between 2011 and 2016—it decreased from N34,750 to N30,125 between 2011 and 2013; although it increased between 2013 and 2016 (N32,850), it was not as high as 2011 levels.

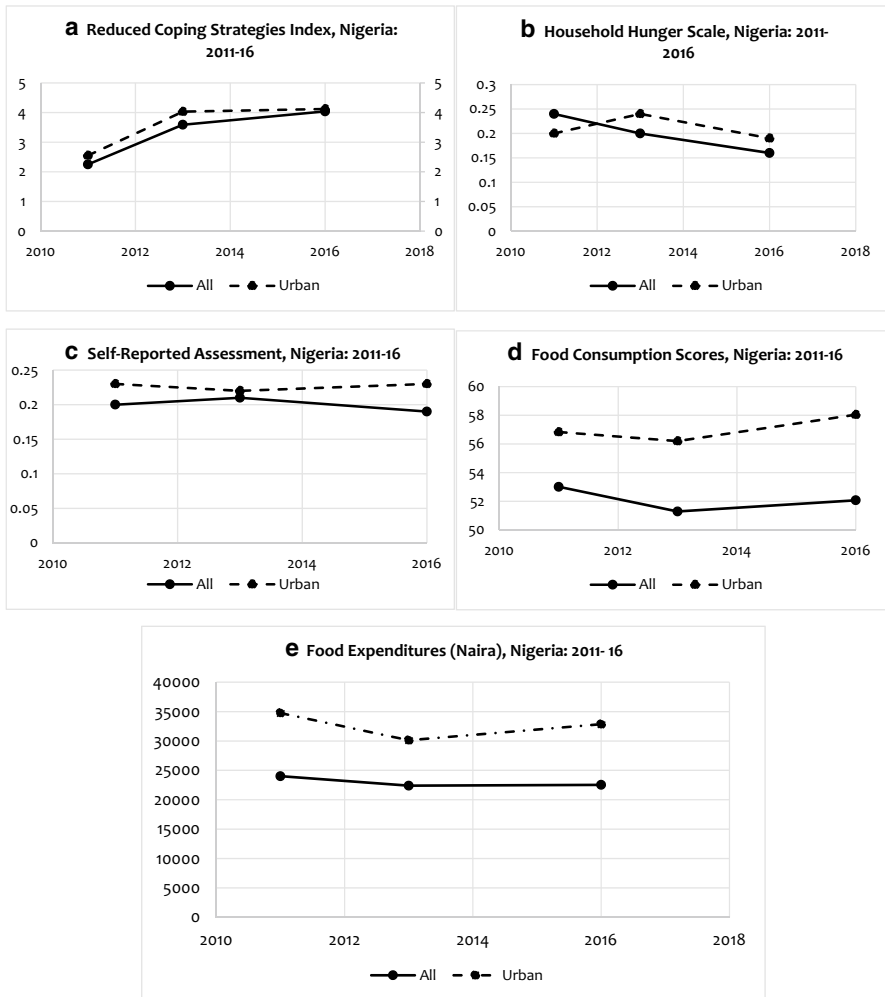


Fig. 2 Household food security-trends, Nigeria: 2011–2016

Spatial distribution of food insecurity in Nigeria, 2011–2016

Figure 3 shows the spatial distribution of food insecurity in Nigeria for each study year, as proxied by the number of coping strategies adopted by households in the presence of food deficits.² The number of strategies, weighted by their frequency, range from 0 to 56 with higher values indicative of higher food insecurity. The maps provide a visual description of the distribution of food security across the country and show how this has changed over time. The benefits of maps over non-visual food security statistics is that we are able to discern spatial relationships and observe spatial outliers in food security across the country.³

² Other measures of food security (not shown) show similar spatial patterns of food security in Nigeria.

³ All spatial analyses were carried out using ArcGIS software.

Consistent with the World Food Programme (2019), the food security situation in north eastern states of Borno, Adamawa and Yobe is worsening over time, a situation attributable to the armed insurgency in the section of the country. Worsening food security is also observed in south-east states such as Benue and Ebonyi, and in south–south states such as Cross river and Delta. Recent interventions like the 2018 USAID-funded Global Food Security Strategy (GFSS) in these states are evidence of deteriorating food security. Finally, high food insecurity in Lagos state is observed in Fig. 3. The government's recognition of this situation has led to the prioritization of the domestication of the Nigeria Agricultural Sector Food Security and Nutrition Strategy 2016–2025 for the state; Lagos State is one of only three other States that have been selected for implementation of the strategy.

Results and discussions

Household-level regressions

Results of fixed effects regressions of various household food security measures on fertility and other controls are summarized in Tables 3, 4, 5, 6 and 7. Each table represents a regression of one measure of fertility on five (5) measures of food security, both for the aggregate sample and for the urban sample.⁴

A consistent relationship is observed between household sizes and food security—larger households have worse food security outcomes and are more likely to report being food insecure.

In Table 3, in the full sample, larger household sizes adopt more coping strategies (e.g., skipping meals, reducing portion sizes, eating cheap low-quality meals, borrowing money from family and friends to buy food, and having adults forego meals so children can eat) in the face of food deficits; have lower per capita food expenditures; and are more likely to declare food shortages in the year preceding the survey. In the urban sample, larger households adopt more coping strategies and have lower per capita food spending, indications of lower food security. The finding that larger households adopt more food compromise strategies is consistent with existing literature (Tefera and Tefera 2014; Olayemi 2012). It is important to note however that in the aggregate sample, larger households have better dietary diversity. This is consistent with Workicho et al. (2016), who explain that families with larger members may have a larger labor force who can invest more in agricultural practices, resulting in increased production, or increased income by paid labor.

In Table 4, households with higher dependency ratios adopt more coping strategies and have lower per capita food security. It is worth pointing out that while similar results are found in the urban sample, the effects of higher dependency ratios are stronger in urban households. Higher dependency ratios imply that members are at a non-productive age and are therefore a liability for the family to feed. These results are consistent with others found in the literature (Babatunde et al. 2007; Gebrehiwot and van der Veen 2014)

Tables 5, 6 and 7 present results from the effects of larger numbers of own children, all household children under 5 and all household children under 15, respectively, on various measures of food security. In Table 5, households with higher numbers of

⁴ All main results for the relationship between fertility and food security measures are summarized in Table 4.

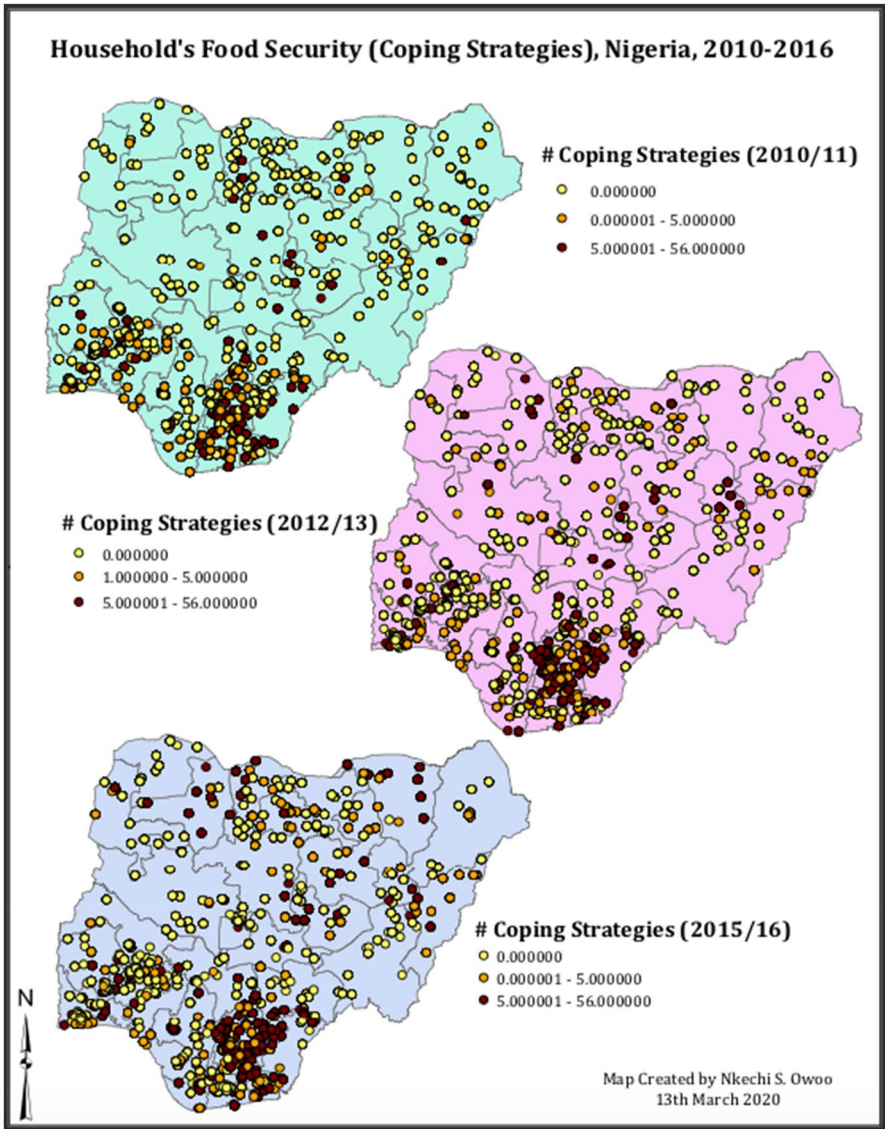


Fig. 3 Map of food security (food deficit coping strategies) in Nigeria, 2011–2016

Table 3 Regressions of household food security measures on *household size* and other explanatory variables, NGHS, 2011–2016

	Full sample					Urban sample				
	RCSI	HHS	FCS	Per cap food exp	Insuff food	RCSI	HHS	FCS	Per cap food exp	Insuff food
Household size	0.27*** (4.31)	0.01 (1.34)	0.37* (1.84)	-0.28*** (-38.41)	0.02*** (2.90)	0.39** (2.03)	0.01 (0.60)	0.04 (0.07)	-0.26*** (-14.19)	0.00 (0.10)
Male head	-0.69 (-1.21)	0.07 (0.92)	3.01* (1.68)	0.04 (0.69)	-0.11* (-1.66)	-1.64 (-0.90)	0.19 (1.00)	1.52 (0.30)	-0.06 (-0.34)	-0.30* (-1.79)
Age head	-0.00 (-0.26)	-0.00** (-2.37)	-0.02 (-0.55)	0.00 (0.36)	-0.00** (-2.36)	-0.02 (-0.36)	-0.00 (-0.93)	0.06 (0.49)	0.00 (0.72)	-0.00 (-0.13)
Basic educ.	-0.14 (-0.49)	0.02 (0.41)	-0.38 (-0.42)	-0.02 (-0.74)	-0.04 (-0.66)	-0.13 (-0.13)	-0.13 (-1.27)	6.57** (2.39)	0.10 (1.13)	-0.26 (-1.29)
Secondary educ.	0.02 (0.05)	-0.01 (-0.31)	0.01 (0.01)	-0.09** (-2.45)	0.00 (0.03)	-1.5 (-1.30)	-0.15 (-1.25)	9.19*** (2.88)	0.03 (0.31)	-0.12 (-0.58)
Post-secondary	-0.84** (-2.19)	-0.01 (-0.26)	-0.74 (-0.62)	-0.02 (-0.47)	-0.27*** (-3.30)	-2.21 (-1.60)	-0.11 (-0.74)	12.22*** (3.20)	0.16 (1.24)	-0.41* (-1.87)
Muslim	-0.72 (-0.12)	0.10 (0.13)	-53.4*** (-2.89)	-0.72 (-1.05)	-0.14* (-1.92)	-	-	-	-	0.19 (1.02)
Urban	1.12 (0.65)	0.1 (0.42)	6.53 (1.16)	0.11 (0.53)	0.30*** (4.37)	-	-	-	-	-
Poorer	-0.12 (-0.42)	0.08** (2.02)	-0.83 (-0.94)	0.04 (1.31)	-0.19*** (-3.11)	-0.33 (-0.19)	0.57*** (3.25)	3.74 (0.80)	0.18 (1.13)	-0.53** (-1.99)
Middle wealth	-0.68** (-2.06)	0.07 (1.57)	0.33 (0.32)	0.09** (2.27)	-0.20*** (-3.02)	0.11 (0.07)	0.64*** (3.65)	8.88* (1.91)	0.29* (1.85)	-0.80*** (-3.27)
Richer	-0.96** (-2.37)	0.05 (0.88)	1.43 (1.11)	0.11** (2.23)	-0.38*** (-4.99)	-0.3 (-0.16)	0.61*** (3.26)	10.52*** (2.11)	0.33* (1.91)	-0.80*** (-3.16)
Richest	-1.17** (-2.30)	0.04 (0.54)	2.37 (1.48)	0.16*** (2.72)	-0.69*** (-7.37)	-0.67 (-0.34)	0.59*** (2.90)	9.84* (1.83)	0.23 (1.24)	-1.26*** (-4.62)

Table 3 (continued)

	Full sample				Urban sample					
	RCSI	HHS	FCS	Per cap food exp	Insuff food	RCSI	HHS	FCS	Per cap food exp	Insuff food
TLU	-0.00 (-0.67)	-0.00 (-0.16)	0.00 (0.31)	0.00 (0.95)	-0.01* (-1.74)	-0.02 (-0.24)	-0.00 (-0.25)	0.67** (2.53)	-0.01 (-1.12)	-0.01 (-0.93)
Farming	-0.46 (-0.61)	-0.58*** (-5.99)	-1.19 (-0.53)	-0.05 (-0.65)	-0.17 (-1.59)	-0.45 (-0.32)	-0.06 (-0.43)	-1.45 (-0.38)	-0.20 (-1.52)	-0.06 (-0.39)
Head employed	0.19 (0.61)	0.06 (1.43)	-0.58 (-0.61)	0.06 (1.60)	-0.18*** (-2.61)	0.45 (0.44)	-0.03 (-0.26)	3.19 (1.13)	0.16 (1.64)	-0.13 (-0.66)
Shocks	1.49*** (4.19)	0.04 (0.92)	2.23** (1.98)	0.05 (1.23)	0.45*** (5.02)	-0.79 (-0.66)	-0.09 (-0.70)	3.44 (1.05)	0.16 (1.38)	0.67*** (2.80)
Zone/wave controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2_w	0.12	0.05	0.03	0.38		0.16	0.07	0.11	0.47	
R2_b	0.1	0.01	0	0.58		0.21	0	0.05	0.59	
R2_o	0.11	0	0	0.53		0.21	0	0.09	0.57	
N	6827	6893	6801	6895	6885	969	971	961	971	969

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4 Regressions of household food security measures on *dependency ratio* and other explanatory variables, NGHIS, 2011–2016

	Full sample					Urban sample				
	RCSI	HHS	FCS	Per cap food exp	Insuff	RCSI	HHS	FCS	Per cap food exp	Insuff
Dependency rat.	1.19** (1.96)	0.11 (1.30)	3.01 (1.58)	-0.68*** (-8.28)	0.19* (1.87)	4.74** (2.55)	0.11 (0.59)	2.83 (0.55)	-1.01*** (-4.84)	0.23 (0.96)
Male head	-0.41 (-0.72)	0.08 (1.07)	3.37* (1.89)	-0.24*** (-3.22)	-0.09 (-1.29)	-1.56 (-0.86)	0.19 (1.04)	1.30 (0.26)	-0.31 (-1.53)	-0.31* (-1.87)
Age head	-0.01 (-0.36)	-0.00** (-2.47)	-0.03 (-0.67)	-0.00 (-0.00)	-0.00** (-2.30)	-0.03 (-0.75)	-0.00 (-1.01)	0.05 (0.40)	0.01 (1.39)	-0.00 (-0.18)
Basic educ.	-0.08 (-0.28)	0.01 (0.34)	-0.24 (-0.26)	-0.07* (-1.86)	-0.02 (-0.27)	0.17 (0.17)	-0.12 (-1.19)	6.72** (2.44)	0.03 (0.23)	-0.24 (-1.19)
Secondary educ.	0.20 (0.60)	-0.01 (-0.25)	0.35 (0.33)	-0.25*** (-5.42)	0.05 (0.67)	-1.07 (-0.93)	-0.14 (-1.15)	9.35*** (2.93)	-0.13 (-1.02)	-0.08 (-0.37)
Post-secondary	-0.64* (-1.67)	-0.02 (-0.37)	-0.40 (-0.33)	-0.20*** (-3.90)	-0.23*** (-2.72)	-1.52 (-1.11)	-0.09 (-0.61)	12.44*** (3.28)	-0.15 (-0.96)	-0.36 (-1.58)
Muslim	-1.07 (-0.18)	0.09 (0.11)	-53.9*** (-2.92)	-0.32 (-0.40)	-0.13* (-1.77)	-	-	-	-	0.19 (-1.01)
Urban	1.07 (0.62)	0.09 (0.40)	6.46 (1.15)	0.17 (0.72)	0.30*** (4.28)	-	-	-	-	-
Poorer	-0.09 (-0.31)	0.08** (2.03)	-0.78 (-0.89)	0.01 (0.30)	-0.19*** (-2.98)	-0.28 (-0.16)	0.57*** (3.26)	3.74 (0.80)	0.16 (0.84)	-0.53** (-1.98)
Middle wealth	-0.60* (-1.81)	0.07 (1.63)	0.44 (0.43)	0.00 (0.10)	-0.19*** (-2.89)	0.29 (0.17)	0.64*** (3.67)	8.96* (1.93)	0.25 (1.31)	-0.80*** (-3.27)
Richer	-0.90** (-2.21)	0.05 (0.89)	1.56 (1.21)	0.03 (0.56)	-0.36*** (-4.85)	-0.19 (-0.11)	0.61*** (3.27)	10.58** (2.12)	0.32 (1.60)	-0.80*** (-3.21)
Richest	-1.09** (-2.15)	0.04 (0.55)	2.50 (1.56)	0.07 (1.05)	-0.68*** (-7.21)	-0.59 (-0.30)	0.59*** (2.91)	9.88* (1.84)	0.22 (1.03)	-1.26*** (-4.72)

Table 4 (continued)

	Full sample					Urban sample				
	RCSI	HHS	FCS	Per cap food exp	Insuff	RCSI	HHS	FCS	Per cap food exp	Insuff
TLU	-0.00 (-0.71)	-0.00 (-0.18)	0.00 (0.30)	0.00 (1.10)	-0.01 (-1.59)	-0.05 (-0.47)	-0.00 (-0.31)	0.65** (2.46)	-0.01 (-0.54)	-0.01 (-0.88)
Farming	-0.48 (-0.64)	-0.59*** (-5.99)	-1.23 (-0.55)	-0.02 (-0.24)	-0.17 (-1.57)	-0.5 (-0.36)	-0.06 (-0.43)	-1.51 (-0.39)	-0.22 (-1.43)	-0.06 (-0.39)
Head employed	0.15 (0.50)	0.06 (1.36)	-0.63 (-0.66)	0.08** (2.00)	-0.17** (-2.50)	0.41 (0.40)	-0.03 (-0.27)	3.15 (1.12)	0.16 (1.36)	-0.14 (-0.69)
Shocks	1.49*** (4.19)	0.04 (0.92)	2.23*** (1.99)	0.06 (1.20)	0.45*** (4.98)	-0.62 (-0.52)	-0.08 (-0.68)	3.64 (1.10)	0.20 (1.46)	0.67*** (2.83)
Zone/wave controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2_w	0.12	0.05	0.03	0.15	0.16	0.16	0.07	0.11	0.25	0.25
R2_b	0.09	0.01	0	0.12	0.22	0.22	0	0.05	0.04	0.04
R2_o	0.11	0	0	0.12	0.23	0.23	0	0.09	0.06	0.06
N	6828	6895	6802	6895	6886	969	971	961	971	969

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5 Regressions of household food security measures on *own children* and other explanatory variables, NGHS, 2011–2016

	Full sample					Urban sample				
	RCSI	HHS	FCS	Per cap food exp	Insuff	RCSI	HHS	FCS	Per cap food exp	Insuff
Own children	0.25** (2.51)	0.05*** (3.48)	0.04 (0.12)	-0.19*** (-14.62)	0.01* (1.66)	0.36 (1.14)	0.03 (1.04)	-1.18 (-1.38)	-0.21*** (-6.15)	-0.01 (-0.43)
Male head	-0.43 (-0.76)	0.08 (1.00)	3.40* (1.91)	-0.22*** (-3.00)	-0.10 (-1.42)	-1.13 (-0.62)	0.20 (1.09)	1.62 (0.33)	-0.40** (-2.00)	-0.28* (-1.70)
Age head	-0.01 (-0.38)	-0.01*** (-2.77)	-0.02 (-0.46)	0.00 (0.83)	-0.00** (-2.30)	-0.02 (-0.43)	-0.00 (-0.99)	0.07 (0.58)	0.01 (1.03)	-0.00 (-0.09)
Basic educ.	-0.15 (-0.50)	0.01 (0.13)	-0.35 (-0.38)	-0.03 (-0.78)	-0.04 (-0.59)	-0.17 (-0.17)	-0.14 (-1.32)	6.86** (2.50)	0.13 (1.15)	-0.26 (-1.28)
Secondary educ.	0.09 (0.28)	-0.02 (-0.53)	0.13 (0.12)	-0.18*** (-4.03)	0.01 (0.15)	-1.42 (-1.23)	-0.15 (-1.28)	9.56*** (3.00)	-0.02 (-0.19)	-0.12 (-0.57)
Post-secondary	-0.77** (-2.01)	-0.04 (-0.73)	-0.57 (-0.48)	-0.11** (-2.21)	-0.27*** (-3.21)	-2.01 (-1.45)	-0.11 (-0.77)	12.85*** (3.39)	0.02 (0.12)	-0.41* (-1.85)
Muslim	-0.89 (-0.15)	0.13 (0.16)	-53.99*** (-2.92)	-0.47 (-0.60)	-0.14* (-1.82)	-	-	-	-	0.2 (1.06)
Urban	1.05 (0.61)	0.09 (0.39)	6.41 (1.14)	0.18 (0.79)	0.30*** (4.32)	-	-	-	-	-
Poorer	-0.1 (-0.35)	0.08** (1.99)	-0.79 (-0.89)	0.02 (0.51)	-0.19*** (-3.03)	-0.35 (-0.20)	0.57*** (3.23)	3.98 (0.85)	0.20 (1.05)	-0.53** (-1.98)
Middle wealth	-0.62* (-1.87)	0.07 (1.57)	0.43 (0.41)	0.02 (0.40)	-0.19*** (-2.91)	0.01 (0.01)	0.62*** (3.57)	9.36** (2.02)	0.36* (1.92)	-0.79*** (-3.24)
Richer	-0.90** (-2.21)	0.05 (0.88)	1.58 (1.22)	0.03 (0.57)	-0.36*** (-4.84)	-0.42 (-0.23)	0.60*** (3.21)	10.82** (2.17)	0.40** (2.01)	-0.79*** (-3.14)
Richest	-1.10** (-2.17)	0.04 (0.52)	2.52 (1.57)	0.08 (1.20)	-0.68*** (-7.22)	-0.83 (-0.42)	0.57*** (2.83)	10.37* (1.93)	0.33 (1.52)	-1.24*** (-4.59)

Table 5 (continued)

	Full sample					Urban sample				
	RCSI	HHS	FCS	Per cap food exp	Insuff	RCSI	HHS	FCS	Per cap food exp	Insuff
TLU	-0.00 (-0.71)	-0.00 (-0.18)	0.00 (0.30)	0.00 (1.13)	-0.01* (-1.65)	-0.02 (-0.24)	-0.00 (-0.26)	0.67** (2.55)	-0.01 (-0.97)	-0.01 (-0.92)
Farming	-0.4 (-0.53)	-0.57*** (-5.81)	-1.2 (-0.53)	-0.10 (-1.02)	-0.17 (-1.55)	-0.29 (-0.21)	-0.05 (-0.36)	-1.72 (-0.45)	-0.30* (-1.93)	-0.06 (-0.40)
Head employed	0.16 (0.53)	0.06 (1.36)	-0.6 (-0.63)	0.08** (2.01)	-0.18*** (-2.62)	0.51 (0.50)	-0.02 (-0.22)	3.05 (1.09)	0.12 (1.05)	-0.12 (-0.62)
Shocks	1.44*** (4.05)	0.04 (-0.79)	2.22** (1.98)	0.09* (1.81)	0.46*** (5.03)	-0.9 (-0.75)	-0.09 (-0.69)	3.2 (0.98)	0.23* (1.74)	0.66*** (2.79)
Zone/wave controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2_w	0.12	0.05	0.03	0.18	0.15	0.15	0.08	0.12	0.28	
R2_b	0.09	0.01	0	0.36	0.21	0.21	0	0.04	0.41	
R2_o	0.11	0	0	0.32	0.21	0.21	0	0.07	0.39	
N	6828	6895	6802	6895	6886	969	971	961	971	969

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 Regressions of household food security measures on *number of under 5 children* and other explanatory variables, NGHS, 2011–2016

	Full sample					Urban sample				
	RCSI	HHS	FCS	Per cap food exp	Insuff	RCSI	HHS	FCS	Per cap food exp	Insuff
Under 5	0.17 (1.57)	0.03** (2.39)	-0.13 (-0.38)	-0.15*** (-10.04)	0.05** (2.13)	0.44 (1.14)	-0.01 (-0.33)	0.42 (0.39)	-0.16*** (-3.61)	0.00 (0.05)
Male head	-0.41 (-0.73)	0.08 (1.03)	3.42* (1.92)	-0.23*** (-3.09)	-0.09 (-1.35)	-1.2 (-0.66)	0.21 (1.11)	1.49 (0.30)	-0.38* (-1.83)	-0.29* (-1.80)
Age head	0.00 (0.00)	-0.00** (-2.18)	-0.02 (-0.47)	-0.00* (-1.73)	-0.00 (-1.58)	-0.01 (-0.30)	-0.00 (-0.95)	0.06 (0.51)	0.00 (0.46)	-0.00 (-0.10)
Basic educ.	-0.13 (-0.44)	0.01 (0.22)	-0.34 (-0.37)	-0.04 (-1.14)	-0.03 (-0.43)	-0.22 (-0.22)	-0.12 (-1.21)	6.43*** (2.32)	0.13 (1.13)	-0.26 (-1.29)
Secondary educ.	0.12 (0.35)	-0.02 (-0.43)	0.14 (0.13)	-0.20*** (-4.39)	0.03 (0.42)	-1.43 (-1.24)	-0.14 (-1.17)	9.08*** (2.84)	-0.04 (-0.30)	-0.12 (-0.58)
Post-secondary	-0.73* (-1.91)	-0.03 (-0.57)	-0.54 (-0.45)	-0.14*** (-2.82)	-0.25*** (-3.03)	-2.01 (-1.46)	-0.09 (-0.63)	12.08*** (3.17)	-0.02 (-0.12)	-0.41* (-1.87)
Muslim	-0.91 (-0.15)	0.13 (0.16)	-54.2*** (-2.93)	-0.48 (-0.60)	-0.14* (-1.83)	-	-	-	-	0.19 (-1.04)
Urban	1.05 (0.61)	0.09 (0.40)	6.41 (1.14)	0.17 (0.74)	0.30*** (4.32)	-	-	-	-	-
Poorer	-0.09 (-0.32)	0.08** (2.01)	-0.78 (-0.88)	0.01 (0.39)	-0.19*** (-3.01)	-0.31 (-0.18)	0.57*** (3.26)	3.73 (0.80)	0.16 (0.84)	-0.53*** (-1.99)
Middle wealth	-0.61* (-1.85)	0.07 (1.58)	0.44 (0.42)	0.02 (0.37)	-0.19*** (-2.94)	0.25 (0.15)	0.64*** (3.64)	8.99* (1.93)	0.24 (1.24)	-0.80*** (-3.28)
Richer	-0.90** (-2.21)	0.05 (0.86)	1.59 (1.23)	0.04 (0.65)	-0.37*** (-4.90)	-0.27 (-0.15)	0.61*** (3.24)	10.57*** (2.12)	0.33 (1.59)	-0.79*** (-3.19)
Richest	-1.10** (-2.16)	0.04 (0.51)	2.54 (1.58)	0.08 (1.22)	-0.68*** (-7.22)	-0.66 (-0.33)	0.58*** (2.89)	9.86* (1.84)	0.23 (1.03)	-1.26*** (-4.71)

Table 6 (continued)

	Full sample				Urban sample					
	RCSI	HHS	FCS	Per cap food exp	Insuff	RCSI	HHS	FCS	Per cap food exp	Insuff
TLU	-0.00 (-0.72)	-0.00 (-0.18)	0.00 (0.29)	0.00 (1.14)	-0.01 (-1.58)	-0.03 (-0.26)	-0.00 (-0.24)	0.66** (2.51)	-0.01 (-0.88)	-0.01 (-0.93)
Farming	-0.46 (-0.62)	-0.59*** (-5.97)	-1.21 (-0.54)	-0.03 (-0.35)	-0.17 (-1.58)	-0.4 (-0.28)	-0.06 (-0.41)	-1.46 (-0.38)	-0.24 (-1.53)	-0.06 (-0.39)
Head employed	0.18 (0.57)	0.06 (1.43)	-0.61 (-0.64)	0.07* (1.68)	-0.17** (-2.48)	0.52 (0.50)	-0.03 (-0.27)	3.23 (1.15)	0.13 (1.10)	-0.13 (-0.66)
Shocks	1.48*** (4.15)	0.04 (0.91)	2.23*** (1.98)	0.06 (1.31)	0.46*** (5.02)	-0.9 (-0.75)	-0.09 (-0.77)	3.48 (1.06)	0.25* (1.84)	0.66*** (2.80)
Zone/wave controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2_w	0.12	0.05	0.03	0.16	0.15	0.15	0.07	0.11	0.24	0.24
R2_b	0.08	0.01	0	0.13	0.26	0.26	0	0.05	0.05	0.05
R2_o	0.1	0	0	0.13	0.25	0.25	0	0.09	0.07	0.07
N	6828	6895	6802	6895	6886	969	971	961	971	969

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7 Regressions of household food security measures on *number of under 15 children* and other explanatory variables, NGHS, 2011–2016

	Full sample					Urban sample				
	RCSI	HHS	FCS	Per cap food exp	Insuff	RCSI	HHS	FCS	Per cap food exp	Insuff
Under 15	0.22*** (2.74)	0.03*** (2.96)	0.38 (1.54)	-0.19*** (-19.00)	0.03*** (2.61)	0.56** (2.19)	0.02 (0.94)	0.37 (0.53)	-0.23*** (-8.58)	0.00 (0.11)
Male head	-0.49 (-0.86)	0.07 (0.91)	3.24* (1.82)	-0.17*** (-2.30)	-0.1 (-1.51)	-1.48 (-0.82)	0.19 (1.01)	1.32 (0.27)	-0.25 (-1.32)	-0.30* (-1.81)
Age head	0.00 (0.02)	-0.00** (-2.19)	-0.02 (-0.39)	-0.00** (-2.03)	-0.00* (-1.71)	-0.01 (-0.19)	-0.00 (-0.85)	0.07 (0.53)	0.00 (0.01)	-0.00 (-0.10)
Basic educ.	-0.1 (-0.35)	0.01 (0.33)	-0.31 (-0.34)	-0.07* (-1.83)	-0.03 (-0.48)	-0.06 (-0.06)	-0.13 (-1.24)	6.59** (2.40)	0.07 (0.64)	-0.26 (-1.29)
Secondary educ.	0.17 (0.51)	-0.01 (-0.24)	0.23 (0.22)	-0.25*** (-5.71)	0.03 (0.44)	-1.31 (-1.14)	-0.14 (-1.20)	9.20*** (2.90)	-0.09 (-0.71)	-0.12 (-0.57)
Post-secondary	-0.68* (-1.79)	-0.02 (-0.42)	-0.52 (-0.44)	-0.18*** (-3.71)	-0.25*** (-2.96)	-1.85 (-1.35)	-0.09 (-0.67)	12.24*** (3.24)	-0.08 (-0.53)	-0.41* (-1.87)
Muslim	-0.87 (-0.15)	0.12 (0.15)	-53.6*** (-2.90)	-0.52 (-0.67)	-0.14* (-1.89)	-	-	-	-	0.19 (-1.03)
Urban	1.17 (0.68)	0.11 (0.47)	6.54 (1.16)	0.07 (0.30)	0.30*** (4.35)	-	-	-	-	-
Poorer	-0.09 (-0.33)	0.08** (2.02)	-0.79 (-0.89)	0.01 (0.40)	-0.19*** (-3.02)	-0.17 (-0.10)	0.58*** (3.29)	3.82 (0.82)	0.11 (0.62)	-0.53** (-1.99)
Middle wealth	-0.62* (-1.89)	0.07 (1.56)	0.4 (0.38)	0.03 (0.61)	-0.20*** (-2.96)	0.32 (0.19)	0.65*** (3.70)	9.00* (1.94)	0.21 (1.14)	-0.80*** (-3.28)
Richer	-0.93** (-2.27)	0.05 (0.82)	1.52 (1.18)	0.06 (1.07)	-0.37*** (-4.94)	-0.16 (-0.09)	0.62*** (3.29)	10.62** (2.13)	0.28 (1.48)	-0.80*** (-3.18)
Richest	-1.11** (-2.19)	0.03 (0.50)	2.47 (1.54)	0.10 (1.45)	-0.68*** (-7.29)	-0.56 (-0.29)	0.59*** (2.93)	9.91* (1.84)	0.19 (0.93)	-1.26*** (-4.68)

Table 7 (continued)

	Full sample					Urban sample				
	RCSI	HHS	FCS	Per cap food exp	Insuff	RCSI	HHS	FCS	Per cap food exp	Insuff
TLU	-0.00 (-0.70)	-0.00 (-0.17)	0.00 (0.31)	0.00 (1.06)	-0.01* (-1.68)	-0.04 (-0.42)	-0.00 (-0.33)	0.65** (2.47)	-0.00 (-0.32)	-0.01 (-0.93)
Farming	-0.44 (-0.59)	-0.58*** (-5.92)	-1.15 (-0.51)	-0.07 (-0.71)	-0.17 (-1.59)	-0.27 (-0.19)	-0.05 (-0.38)	-1.36 (-0.36)	-0.29*** (-1.99)	-0.06 (-0.39)
Head employed	0.15 (0.48)	0.05 (1.32)	-0.64 (-0.66)	0.09** (2.35)	-0.18*** (-2.64)	0.49 (0.48)	-0.03 (-0.25)	3.2 (1.14)	0.14 (1.25)	-0.13 (-0.66)
Shocks	1.46*** (4.11)	0.04 (0.85)	2.19* (1.95)	0.08* (1.73)	0.45*** (4.98)	-0.75 (-0.63)	-0.08 (-0.67)	3.57 (1.09)	0.18 (1.43)	0.67*** (2.80)
Zone/wave controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2_w	0.12	0.05	0.03	0.21	0.16	0.16	0.07	0.11	0.33	0.33
R2_b	0.11	0.01	0	0.29	0.22	0.22	0	0.05	0.34	0.34
R2_o	0.12	0	0	0.27	0.22	0.22	0	0.09	0.36	0.36
N	6828	6895	6802	6895	6886	969	971	961	971	969

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

own children have worse food security outcomes—these households tend to adopt more coping strategies, experience more extreme hunger and also have lower per capita food expenditures. In the urban households, higher numbers of own children have lower per capita food expenditures. In Table 6, households with more children under 5 years of age experience more severe forms of hunger, have lower per capita incomes and are also more likely to report that they experienced food shortages in the year prior to the survey. In Table 7, households with more children under 15 years of age appear to adopt more coping strategies, experience more extreme forms of hunger, have lower per capita food expenditures and are also more likely to report food shortages. Urban households with more children under 15 years of age also adopt more coping strategies and have lower per capita expenditures, all indications of poorer food security. All of these results reaffirm the adverse effects of large families on household-level food security.

Individual-level regressions

Results are also presented for effects of household sizes on individual-level food security measures in Tables 8, 9, 10, 11 and 12. Generally, children from larger households with more dependents have worse short- and long-term nutritional outcomes. This relationship is observed in both the aggregate and urban samples.⁵

This finding is consistent with the dilution theory (Blake 1981) which predicts that larger families may decrease the amount of resources (e.g., time, energy, money, food) available for each child, with implications for social and physical development. Given the assumption that parental resources are finite, as the number of children increases, family resources will be spread more thinly with negative effects on children's outcomes. In summary, the more children are present, the lower the quality of each child, an argument similar to Becker's quality-quantity trade-off proposition. Table 13 synthesizes all the main results of the fertility-food security associations from both the household- and child-level regressions.

Other results from household- and individual-level regressions are worth mentioning—education of household members is associated with better dietary diversity. This is consistent with other findings which argue that educated household heads are more aware of possible advantages of modernized agriculture by means of technological inputs; education also enables them to read and understand instructions on fertilizer packs which enhances the household's food supply (Endale et al. 2014; Regassa and Stoecker 2011). Education also encourages better food and nutrition practices (Powell et al. 2017). Lack of access to farmland is associated with worse food security. This is

⁵ All main results for the relationship between fertility and food security measures are summarized in Table 4.

Table 8 Regressions of child anthropometric measures on *household size* and other explanatory variables, NGHS, 2011–2016

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
Household size	−0.02 (−0.17)	−0.14* (−1.78)	−0.23*** (−2.62)	−0.06 (−0.69)
Mother age	−0.00 (−0.16)	−0.02 (−0.90)	0.02 (1.61)	−0.01 (−1.04)
Mother working	0.32 (1.17)	0.10 (0.45)	0.25 (0.71)	0.73** (2.18)
Basic education (mother)	0.07 (0.19)	0.06 (0.18)	0.13 (0.39)	−0.83** (−2.52)
Secondary education (mother)	0.69 (1.53)	0.14 (0.36)	0.11 (0.32)	−0.67* (−1.93)
Post-secondary (mother)	1.04 (1.54)	0.36 (0.69)	0.61 (1.28)	−0.46 (−1.03)
Father age	0.01 (0.42)	−0.01 (−0.64)	−0.00 (−0.32)	−0.01 (−0.57)
Father working	0.71 (1.43)	0.39 (1.00)	1.17 (1.07)	0.54 (0.51)
Basic education (father)	0.06 (0.14)	0.09 (0.26)	0.61 (1.28)	0.28 (0.62)
Secondary education (father)	−0.43 (−0.81)	0.65 (1.48)	0.34 (0.69)	0.45 (0.96)
Post-secondary (father)	−0.63 (−0.91)	−0.16 (−0.29)	0.41 (0.73)	0.55 (1.08)
Polygamy	−0.42 (−0.68)	0.93* (1.82)	0.30 (0.82)	−0.54 (−1.62)
Child age	−0.11* (−1.72)	0.08 (1.55)	0.08 (0.99)	0.21*** (2.70)
Male child	−0.15 (−1.09)	0.03 (0.25)	0.41* (1.84)	0.02 (0.08)
Birth order	−0.17 (−1.48)	−0.04 (−0.40)	0.20** (2.11)	0.17* (1.93)
Muslim	0.14 (0.07)	−1.94 (−1.13)	0.01 (0.04)	−0.88*** (−2.78)
Urban	−0.69 (−0.34)	0.79 (0.46)	0.00 (.)	0.00 (.)
Poorer	−0.74** (−2.01)	−0.06 (−0.21)	0.43 (0.62)	−0.47 (−0.72)
Middle	−1.05*** (−2.65)	−0.07 (−0.20)	0.08 (0.14)	−0.25 (−0.50)
Richer	−0.93** (−2.00)	−0.34 (−0.88)	−0.16 (−0.34)	−0.15 (−0.32)
Richest	−0.93* (−1.77)	−0.50 (−1.16)	0.35 (0.74)	0.34 (0.72)

Table 8 (continued)

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
Insurance	0.29 (0.63)	0.04 (0.11)	-0.29 (-0.65)	0.22 (0.51)
TLU	0.02 (0.58)	-0.04 (-1.16)	0.05 (1.01)	-0.08 (-1.65)
Farming	-1.74** (-2.37)	-0.27 (-0.44)	-0.00 (-0.01)	0.17 (0.56)
Shocks	0.50 (1.25)	-0.07 (-0.22)	-0.66 (-1.04)	-0.25 (-0.41)
Wave/zone controls	Yes	Yes	Yes	Yes
Household fixed effects	Yes	Yes	No	No
R2	0.63	0.62	0.33	0.31
<i>N</i>	1428	1473	208	217

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

consistent with McDonald et al. (2015) who find that greater cultivable land increases food production and therefore improves dietary diversity. In this study, we find that wealthy households are associated with better food security. Household wealth is perceived to affect dietary diversity both directly through greater affordability of food, as well as indirectly by modifying agrobiodiversity, i.e., wealthier households can purchase more types of seeds and other agricultural inputs and also employ farmhands to assist with agricultural production (Powell et al. 2017).

The presence of economic shocks was found to worsen food security. Existing literature finds that during idiosyncratic shocks such as food price hikes, loss of crops, among others, households have worse food security outcomes (Maxwell 1996; Gupta et al. 2015). Economic factors such as household heads employment also affects households' food security status. At the individual level, we also find that Muslim children, girls and children that reside in polygynous households have worse nutritional outcomes. The finding that children from polygynous households have worse food security outcome than children from monogamous households is consistent with existing literature (Han and Foltz 2015; Owoo 2018). This is because women in monogamous households may enjoy higher bargaining power, which allows them to allocate sufficient resources to their children.

Table 9 Regressions of child anthropometric measures on *dependency ratio* and other explanatory variables, NGHS, 2011–2016

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
Dependency ratio	−2.99** (−2.57)	−1.34 (−1.44)	−0.69 (−0.74)	−0.03 (−0.03)
Mother age	0.00 (0.01)	−0.02 (−0.86)	0.02 (1.52)	−0.01 (−1.06)
Mother working	0.33 (1.24)	0.10 (0.47)	0.20 (0.57)	0.73** (2.15)
Basic education (mother)	0.12 (0.32)	0.08 (0.23)	0.01 (0.04)	−0.85** (−2.58)
Secondary education (mother)	0.77* (1.71)	0.17 (0.46)	−0.10 (−0.27)	−0.71** (−2.07)
Post-secondary (mother)	0.95 (1.41)	0.26 (0.50)	0.29 (0.62)	−0.53 (−1.20)
Father age	0.01 (0.49)	−0.02 (−0.72)	−0.01 (−0.56)	−0.01 (−0.64)
Father working	0.75 (1.54)	0.46 (1.20)	1.07 (0.95)	0.49 (0.46)
Basic education (father)	0.23 (0.51)	0.13 (0.34)	0.38 (0.80)	0.23 (0.51)
Secondary education (father)	−0.30 (−0.56)	0.66 (1.51)	0.23 (0.47)	0.42 (0.88)
Post-secondary (father)	−0.42 (−0.61)	−0.14 (−0.26)	0.34 (0.60)	0.55 (1.08)
Polygamy	−0.68 (−1.13)	0.63 (1.25)	−0.24 (−0.76)	−0.68** (−2.48)
Child age	−0.12** (−2.09)	0.04 (0.86)	−0.01 (−0.07)	0.19*** (2.63)
Male child	−0.14 (−1.05)	0.03 (0.29)	0.40* (1.76)	0.02 (0.08)
Birth order	−0.16* (−1.81)	−0.12 (−1.62)	−0.00 (−0.06)	0.12** (2.48)
Muslim	0.43 (0.21)	−2.04 (−1.18)	−0.01 (−0.04)	−0.88*** (−2.77)
Urban	−0.87 (−0.43)	0.66 (0.38)	0.00 (.)	0.00 (.)
Poorer	−0.82** (−2.24)	−0.12 (−0.44)	0.30 (0.43)	−0.48 (−0.74)
Middle	−1.07*** (−2.73)	−0.07 (−0.23)	−0.07 (−0.13)	−0.26 (−0.51)
Richer	−0.93** (−2.01)	−0.32 (−0.83)	−0.15 (−0.31)	−0.13 (−0.28)
Richest	−1.04** (−1.99)	−0.55 (−1.26)	0.12 (0.26)	0.29 (0.63)

Table 9 (continued)

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
Insurance	0.40 (0.86)	0.04 (0.10)	0.01 (0.02)	0.29 (0.70)
TLU	0.01 (0.23)	-0.04 (-1.42)	0.06 (1.13)	-0.08 (-1.63)
Farming	-1.76** (-2.41)	-0.28 (-0.46)	0.21 (0.65)	0.22 (0.74)
Shocks	0.49 (1.23)	-0.07 (-0.23)	-0.60 (-0.92)	-0.25 (-0.40)
Wave/zone controls	Yes	Yes	Yes	Yes
Household fixed effects	Yes	Yes	No	No
R2	0.63	0.62	0.31	0.31
<i>N</i>	1428	1473	208	217

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Conclusion

Nigeria adopts a predominantly supply-side approach to curbing food insecurity in the country. This is evidenced by the plethora of food and nutrition policies that have been developed, even in recent periods, to boost agricultural production in the country. National policies include the Agricultural Sector Food Security and Nutrition Strategy (2016–2025), the National Policy on Food and Nutrition, the National Strategic Plan of Action for Nutrition (2014–2019), among others. Population trends may be expected to continue to affect the demand for food. It is therefore important that demographic projections be incorporated into plans to improve agricultural production and achieve greater food security. It is important that these supply-side solutions be complemented with demand-side approaches as well, in order to reduce the food deficit in households and achieve the goal of food security. Currently, only 1-in-10 married women use a modern contraceptive method, indicating some scope for improvement. The National Family Planning Communication Plan for the period 2017–2020 aims to increase the use of modern contraceptives in Nigeria and is a step in the right direction.

Table 10 Regressions of child anthropometric measures on *own child* and other explanatory variables, NGHS, 2011–2016

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
Own child	0.04 (0.36)	−0.09 (−0.92)	−0.16 (−1.21)	0.08 (0.61)
Mother age	−0.00 (−0.18)	−0.02 (−0.85)	0.02 (1.55)	−0.01 (−1.09)
Mother working	0.31 (1.15)	0.12 (0.53)	0.21 (0.58)	0.74** (2.20)
Basic education (mother)	0.06 (0.15)	0.09 (0.28)	0.02 (0.07)	−0.84** (−2.56)
Secondary education (mother)	0.69 (1.53)	0.13 (0.34)	−0.09 (−0.24)	−0.70** (−2.04)
Post-secondary (mother)	1.04 (1.53)	0.28 (0.55)	0.32 (0.69)	−0.53 (−1.21)
Father age	0.01 (0.41)	−0.02 (−0.75)	−0.01 (−0.59)	−0.01 (−0.61)
Father working	0.73 (1.47)	0.41 (1.06)	1.13 (1.01)	0.40 (0.37)
Basic education (father)	0.07 (0.15)	0.03 (0.09)	0.41 (0.87)	0.20 (0.45)
Secondary education (father)	−0.44 (−0.81)	0.62 (1.41)	0.23 (0.47)	0.39 (0.82)
Post-secondary (father)	−0.65 (−0.93)	−0.20 (−0.36)	0.36 (0.64)	0.54 (1.07)
Polygamy	−0.45 (−0.75)	0.74 (1.49)	−0.06 (−0.17)	−0.76** (−2.49)
Child age	−0.12** (−2.01)	0.06 (1.14)	0.05 (0.59)	0.16* (1.93)
Male child	−0.15 (−1.10)	0.03 (0.28)	0.43* (1.89)	0.01 (0.04)
Birth order	−0.19* (−1.89)	−0.09 (−1.06)	0.14 (1.05)	0.05 (0.39)
Muslim	0.04 (0.02)	−2.01 (−1.16)	0.03 (0.09)	−0.89*** (−2.80)
Urban	−0.68 (−0.34)	0.65 (0.37)	0.00 (.)	0.00 (.)
Poorer	−0.75** (−2.04)	−0.07 (−0.27)	0.21 (0.31)	−0.43 (−0.64)
Middle	−1.05*** (−2.66)	−0.06 (−0.17)	−0.06 (−0.11)	−0.22 (−0.44)
Richer	−0.94** (−2.01)	−0.31 (−0.81)	−0.18 (−0.38)	−0.09 (−0.19)
Richest	−0.93* (−1.78)	−0.49 (−1.14)	0.16 (0.34)	0.30 (0.65)

Table 10 (continued)

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
Insurance	0.29 (0.63)	−0.01 (−0.02)	−0.11 (−0.24)	0.34 (0.81)
TLU	0.02 (0.57)	−0.04 (−1.20)	0.05 (0.91)	−0.07 (−1.54)
Farming	−1.69** (−2.28)	−0.35 (−0.57)	0.09 (0.28)	0.28 (0.90)
Shocks	0.50 (1.23)	−0.06 (−0.21)	−0.70 (−1.07)	−0.24 (−0.39)
Wave/zone controls	Yes	Yes	Yes	Yes
Household fixed effects	Yes	Yes	No	No
R ²	0.63	0.62	0.31	0.31
<i>N</i>	1428	1473	208	217

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

By increasing the uptake of contraceptives, fertility may be reduced by a reduction in mis-timed and unwanted births, with positive implications for household's food security situations.

Given the 6.5% annual expansion in urbanization in Nigeria, urban policy needs to be developed to include demographic considerations. The eleventh SDG aims to make cities and human settlements inclusive, safe, resilient and sustainable. Cities and other urban areas cannot be sustainable if they are not food secure. Urban policy therefore needs to make deliberate efforts to link both population projections and food security issues in the country. Lagos is one of the largest cities in the world and has been plagued with issues of food security. The Lagos state government has prioritized agriculture and food security in the new government and is one of the four states set to domesticate the Agricultural Sector Food Security and Nutrition Strategy policy (2016–2025). Lagos, as a growing urban settlement, however, does not have an urban policy that links family planning with food security; this is a policy move that should be considered across the country.

I conclude with a caveat about causality in this analysis. Despite the informative and valuable contribution that the paper makes, my attempts to control for potentially omitted variables with the inclusion of a host of controls in the different regression

Table 11 Regressions of child anthropometric measures on *number of under 5 children* and other explanatory variables, NGHS, 2011–2016

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
Under 5	0.05 (0.43)	−0.18* (−1.96)	−0.30** (−2.34)	−0.09 (−0.73)
Mother age	−0.00 (−0.15)	−0.02 (−1.03)	0.01 (0.87)	−0.02 (−1.22)
Mother working	0.33 (1.20)	0.06 (0.26)	0.10 (0.28)	0.68** (1.98)
Basic education (mother)	0.05 (0.14)	0.13 (0.39)	0.04 (0.13)	−0.85** (−2.58)
Secondary education (mother)	0.68 (1.50)	0.18 (0.46)	−0.05 (−0.14)	−0.72** (−2.10)
Post-secondary (mother)	1.03 (1.52)	0.37 (0.71)	0.35 (0.75)	−0.52 (−1.18)
Father age	0.01 (0.44)	−0.02 (−0.82)	−0.01 (−0.42)	−0.01 (−0.60)
Father working	0.72 (1.46)	0.47 (1.21)	1.34 (1.21)	0.60 (0.56)
Basic education (father)	0.03 (0.07)	0.14 (0.37)	0.48 (1.02)	0.26 (0.58)
Secondary education (father)	−0.47 (−0.86)	0.71 (1.61)	0.31 (0.63)	0.46 (0.98)
Post-secondary (father)	−0.66 (−0.94)	−0.20 (−0.38)	0.33 (0.59)	0.54 (1.06)
Polygamy	−0.48 (−0.79)	0.86* (1.71)	−0.04 (−0.14)	−0.61** (−2.13)
Child age	−0.12** (−2.03)	0.05 (1.06)	0.01 (0.14)	0.19*** (2.69)
Male child	−0.15 (−1.09)	0.03 (0.28)	0.44* (1.94)	0.02 (0.12)
Birth order	−0.18** (−2.00)	−0.11 (−1.44)	0.01 (0.26)	0.12** (2.58)
Muslim	0.09 (0.04)	−2.05 (−1.19)	0.01 (0.03)	−0.88*** (−2.78)
Urban	−0.68 (−0.33)	0.71 (0.41)	0.00 (.)	0.00 (.)
Poorer	−0.73** (−1.98)	−0.11 (−0.41)	0.16 (0.23)	−0.53 (−0.81)
Middle	−1.05*** (−2.65)	−0.06 (−0.18)	−0.26 (−0.49)	−0.34 (−0.66)
Richer	−0.93** (−2.00)	−0.33 (−0.85)	−0.31 (−0.64)	−0.20 (−0.43)
Richest	−0.92* (−1.75)	−0.53 (−1.22)	0.06 (0.12)	0.26 (0.56)
Insurance	0.29 (0.63)	−0.01 (−0.03)	−0.06 (−0.14)	0.28 (0.66)

Table 11 (continued)

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
TLU	0.02 (0.59)	-0.04 (-1.28)	0.05 (0.96)	-0.08* (-1.67)
Farming	-1.75** (-2.38)	-0.21 (-0.34)	0.16 (0.53)	0.20 (0.69)
Shocks	0.51 (1.27)	-0.09 (-0.30)	-0.38 (-0.58)	-0.16 (-0.25)
Wave/zone controls	Yes	Yes	Yes	Yes
Household fixed effects	Yes	Yes	No	No
R2	0.63	0.62	0.33	0.31
N	1428	1473	208	217

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12 Regressions of child anthropometric measures on *number of under 15 children* and other explanatory variables, NGHS, 2011–2016

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
Under 15	-0.18* (-1.69)	-0.10 (-1.23)	-0.14 (-1.49)	-0.03 (-0.31)
Mother age	-0.00 (-0.10)	-0.02 (-0.90)	0.02 (1.34)	-0.01 (-1.09)
Mother working	0.36 (1.32)	0.12 (0.55)	0.19 (0.53)	0.72** (2.12)
Basic education (mother)	0.12 (0.32)	0.09 (0.27)	0.01 (0.04)	-0.85** (-2.59)
Secondary education (mother)	0.79* (1.73)	0.19 (0.50)	-0.07 (-0.19)	-0.71** (-2.09)
Post-secondary (mother)	1.14* (1.68)	0.35 (0.68)	0.37 (0.80)	-0.52 (-1.18)
Father age	0.01 (0.43)	-0.02 (-0.72)	-0.01 (-0.53)	-0.01 (-0.63)
Father working	0.66 (1.35)	0.42 (1.09)	1.28 (1.14)	0.55 (0.51)
Basic education (father)	0.17 (0.38)	0.12 (0.31)	0.41 (0.86)	0.24 (0.52)
Secondary education (father)	-0.35 (-0.64)	0.67 (1.51)	0.28 (0.57)	0.44 (0.93)
Post-secondary (father)	-0.51 (-0.73)	-0.15 (-0.27)	0.29 (0.52)	0.54 (1.06)
Polygamy	-0.36 (-0.61)	0.77 (1.55)	-0.11 (-0.34)	-0.65** (-2.27)
Child age	-0.08	0.06	0.02	0.19***

Table 12 (continued)

	Full sample		Urban sample	
	HAZ scores	WHZ scores	HAZ scores	WHZ scores
	(−1.36)	(1.22)	(0.25)	(2.64)
Male child	−0.14	0.03	0.41*	0.02
	(−1.08)	(0.28)	(1.80)	(0.09)
Birth order	−0.09	−0.08	0.07	0.13*
	(−0.85)	(−0.94)	(0.96)	(1.97)
Muslim	0.26	−2.08	0.01	−0.88***
	(0.13)	(−1.21)	(0.04)	(−2.77)
Urban	−1.00	0.56	0.00	0.00
	(−0.49)	(0.32)	(.)	(.)
Poorer	−0.76**	−0.10	0.25	−0.50
	(−2.07)	(−0.36)	(0.37)	(−0.76)
Middle	−1.04***	−0.06	−0.13	−0.28
	(−2.63)	(−0.20)	(−0.24)	(−0.56)
Richer	−0.92**	−0.33	−0.22	−0.15
	(−1.98)	(−0.84)	(−0.45)	(−0.33)
Richest	−0.94*	−0.52	0.12	0.28
	(−1.80)	(−1.20)	(0.24)	(0.61)
Insurance	0.37	0.04	−0.05	0.28
	(0.79)	(0.12)	(−0.11)	(0.68)
TLU	0.02	−0.04	0.06	−0.07
	(0.56)	(−1.27)	(1.23)	(−1.59)
Farming	−1.74**	−0.27	0.17	0.21
	(−2.38)	(−0.44)	(0.53)	(0.71)
Shocks	0.52	−0.06	−0.51	−0.22
	(1.29)	(−0.19)	(−0.78)	(−0.35)
Wave/zone controls	Yes	Yes	Yes	Yes
Household fixed effects	Yes	Yes	No	No
R2	0.63	0.62	0.32	0.31
N	1428	1473	208	217

t statistics in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

specifications, and the use of panel data to control of potentially unobserved, unmeasured variables, it remains a possibility that endogeneity issues may plague the outcome from my estimations. Still, the findings proffer caution about neglecting the potential contribution of demand-side solutions in the resolution of food security problems in Nigeria. The spatial depictions of food security are also a contribution to the existing literature and would be useful for the targeting of necessary policies.

Table 13 Summary of main results, NGHHS, 2011–2016

	Household food security outcomes				Individual food security measures		
	Reduced coping strategies Index	Household hunger Scale	Food consumption scores	Per capita food expenditures (N)	Food insufficiency	Height-for-age	Weight-for-height
<i>Household size</i>							
Full sample	0.27*** (4.31)	0.01 (1.34)	0.37* (1.84)	-0.28*** (-38.41)	0.02*** (2.90)	-0.02 (-0.17)	-0.14* (-1.78)
Urban sample	0.39** (2.03)	0.01 (0.60)	0.04 (0.07)	-0.26*** (-14.19)	0.00 (0.10)	-0.23*** (-2.62)	-0.06 (-0.69)
<i>Dependency ratio</i>							
Full sample	1.19** (1.96)	0.11 (1.30)	3.01 (1.58)	-0.68*** (-8.28)	0.19* (1.87)	-2.99** (-2.57)	-1.34 (-1.44)
Urban sample	4.74** (2.55)	0.11 (0.59)	2.83 (0.55)	-1.01*** (-4.84)	0.23 (0.96)	-0.69 (-0.74)	-0.03 (-0.03)
<i># Own children</i>							
Full sample	0.25** (2.51)	0.05*** (3.48)	0.04 (0.12)	-0.19*** (-14.62)	0.01* (1.66)	0.04 (0.36)	-0.09 (-0.92)
Urban sample	0.36 (1.14)	0.03 (1.04)	-1.18 (-1.38)	-0.21*** (-6.15)	-0.01 (-0.43)	-0.16 (-1.21)	0.08 (0.61)
<i># Under 5 children</i>							
Full sample	0.17 (1.57)	0.03** (2.39)	-0.13 (-0.38)	-0.15*** (-10.04)	0.05** (2.13)	0.05 (0.43)	-0.18* (-1.96)
Urban sample	0.44 (1.14)	-0.01 (-0.33)	0.42 (0.39)	-0.16*** (-3.61)	0.00 (0.05)	-0.30** (-2.34)	-0.09 (-0.73)
<i># Under 15 children</i>							
Full sample	0.22*** (2.74)	0.03*** (2.96)	0.38 (1.54)	-0.19*** (-19.00)	0.03*** (2.61)	-0.18* (-1.69)	-0.10 (-1.23)
Urban sample	0.56** (2.19)	0.02 (0.94)	0.37 (0.53)	-0.23*** (-8.58)	0.00 (0.11)	-0.14 (-1.49)	-0.03 (-0.31)

Bold values indicate main results significant at least at 10% level
t statistics in parentheses: **p* < 0.10, ***p* < 0.05, ****p* < 0.01

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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