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Article

Food insecurity and family structure in Nigeria

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ABSTRACT

The article explores a series of questions and hypotheses related to polygynous family structures and both household and individual-level food security outcomes, using the World Bank Living Standards Measurement Survey data from Nigeria, collected in 2011, 2013 and 2015. A Correlated Random Effects (CRE) model is used to examine the relationship between polygyny and household-level food security, and the degree to which it is mediated by household wealth, size, and livelihood. A Household Fixed Effect model is employed to explore whether a mother's status as monogamous versus polygynous relates systematically to her child's health, and also whether child outcomes of senior wives are better than outcomes of junior wives within polygynous households. At the household level, polygynous households are found to have better food security outcomes than monogamous households with differences in household composition and agricultural livelihood as potential explanatory mechanisms. At the individual level, however, children of polygynous mothers have worse nutrition outcomes than children of monogamous mothers in the long run. *Within* polygynous households, children of junior wives appear to have better nutritional outcomes in the long run, compared to children of more senior wives.

Introduction

Progress toward achieving food security is often cited, with focus typically on global progress toward the Millennium Development and World Food Summit goals, that estimate the proportion and numbers (respectively) of the population that is undernourished (State of Food Security and Nutrition-SOFI, 2015). Nonetheless, not only have the *numbers* of the estimates of those globally affected actually increased in some areas, but progress is uneven. Existing indicators mask the underlying distribution, including both regional variation within countries and variation within households (Barrett, 2010). Among the most difficult issues to understand and measure is that food insecurity is an individual concept, and different members of specific households can experience different outcomes—men versus women, adults versus children, and potentially even different children within the same household.

Nigeria is of particular interest given that the numbers of individuals experiencing food insecurity is rising. According to a Food and Agriculture Organization, FAO (2015) report, despite Nigeria having achieved the reduction of 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 in Nigeria increased from roughly 10 million to almost 13 million from 2010 to 2012. Additionally, there is regional, rural, urban, and cultural variation in food security across the country. Food insecurity in Nigeria is also likely to vary within the households and as a direct function of intra-household characteristics, such as household structure and decision-making processes. Family structure in Nigeria is complex and varied, with potential implications for resource distribution and bargaining power that are likely to be important determinants of food security at the household and individual levels (Nazli & Hamid, nd).

This paper explores the relationship between polygyny (the still common practice of a man marrying more than one wife) and food security, as measured by both household-level dietary diversity and coping strategies indicators, and individual level child anthropometric outcomes. Polygyny is hypothesized to have a significant relationship with food security outcomes at the household level, after controlling for household structure, wealth and other relevant factors. In turn, children of mothers in polygynous unions have different individual health outcomes than children of mothers in monogamous unions. Finally, the mother's status within a polygynous union can also be important and, in particular, children of senior wife mothers in polygynous settings are likely to have different individual health outcomes from children of junior wives.

The question of how polygyny affects the distribution of power and subsequent household welfare has been explored. Some studies find a positive association between polygyny and household welfare (Anderson, Reynolds, Biscaye, Greenaway & Merfeld, 2016; Akresh, Chen & Moore,2012). Akresh et al. (2012) use a game theoretic approach and show that there is greater efficiency in agricultural

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production in polygamous households in West Africa, compared to monogamous households, largely attributable to co-operation among co-wives in this setting. Co-operative outcomes are not always by choice, however. According to Dauphin (2016), a wife may be forced to cooperate under a husband's threat to take an additional wife if she does not. Dauphin (2016) found a negative correlation between polygyny and efficiency, as measured by agricultural production in Benin, Burkina Faso and Senegal. Other studies also find a negative relationship between polygyny and efficiency. For example, Kazianga and Klonner (2009) point to co-wife rivalry as a driver of inefficient outcomes, namely health disparities between wives in rural Mali. Other studies find that efficiency in polygynous households tends to be context-specific. For instance, Han and Foltz (2015) found that the degree of co-wife competition or cooperation in Mali depends on the cultural characteristics of polygyny. Using ethnic groups as a proxy, the authors found that among the Dogon, Fulani, and Bambara, there were differences in child health outcomes as a result of unobserved characteristics linked to ethnicity. Munro, Kebede, Tarazona-Gomez, and Verschoor (2010), however, found no difference in household efficiency between monogamous and polygynous households in their experimental study conducted in northern Nigeria. Here, the total endowment invested in a common pool by monogamous and polygynous wives did not differ, indicating an absence of efficiency loss from polygyny. Where husbands controlled the allocations however, there was higher investments of household resources under monogamous unions; and polygynous husbands' investments tended to favour first wives. Husbands were the ultimate gainers from the household allocation of resources. All of these findings point to ambiguous effects of polygyny on household level measures of food security.

Food security is best considered individually, since different members of the same households can experience different outcomes based on gender, age, or other factors. Different children within the same household may have different food security outcomes (Sellen, 1999; Wagner and Rieger, 2015). The relationship between polygyny and individual children's health outcomes most likely operates through efficiency channels, while at the same time depending on characteristics of the child's mother. Polygyny is generally negatively correlated with female bargaining power; co-wives in polygynous households wield less bargaining power than their monogamous counterparts because the value of individual wives' assets in the latter, on which bargaining power may be based, is smaller, given that multiple wives contribute to household welfare (Anderson et al., 2016).

These relationships are examined using the nationally-representative Nigeria General Household Survey, collected as part of the Living Standards Measurement Survey – Integrated Surveys on Agriculture (LSMS-ISA) project of the World Bank. Three waves of the data are used to run correlated random effects (CRE) and Household fixed effects (FE) estimators, in order to convincingly examine relationships and mechanisms. The present research contributes to the existing literature in the following ways. First, appropriate and nationally representative data is employed in carrying out micro-level analyses of food security in Nigeria. Second, the study builds on literature on both intra-household bargaining and the nature and implications of the practice of polygyny, with the specific application of its implications for food security in Nigeria.

Materials and methods

The study employs nationally-representative data from the Nigerian General Household Survey (GHS), containing information collected from 5000 households. The data consists of three waves, 2010/2011, 2012/2013 and 2014/15, and each wave consists of two seasons, post-planting and post-harvest. Post-harvest data is primarily relied on, only updating missing information using the post-planting rounds, as the data in this season included information on both household-level food security and child anthropometric outcomes that were necessary for the analysis.

The survey defines a household as a social unit consisting of one or more people who are or are not related, and who live in the same household unit; that is, live under the same roof, and who eat together; that is "eat from the same pot". This definition and its application in practice have implications for the nature of the responses to food security questions, in particular for polygynous households. First, while in principle a respondent is to be a knowledgeable person answering on behalf of all household members, a potential limitation lies in that it is difficult to be certain that a respondent in a polygynous setting is in fact answering for all co-wives and children, as opposed to for his or her specific family unit within the household. The child-level analysis, however, overcomes this limitation, as it addresses specific children of a certain age regardless of their mothers' status. Second, this definition of a household also has implications for how polygyny is handled in this paper; some polygynous households may have wives who would not be considered as family members if they live in different locations and therefore do not "eat from the safe pot". Households are classified as being polygynous if co-wives are listed in the household roster, therefore, and just by the husband reporting that he is married to multiple women.

For household-level outcome variables, two indices of food security are constructed, in order to reflect different aspects of the availability of and access to food. First, dietary diversity is examined through the Food Consumption Score (FCS), following the World Food Programme approach put forward by Weismann, Bassett, Benson & Hoddinott (2009). The FCS uses information on the frequency of consumption in the week prior of cereals, tubers, pulses, vegetables, fruits, meats and fish, milk, sugar and oil. Higher scores are indicative of better food security. To reflect other dimensions of food security, such as economic and social access to food, the Reduced Coping Strategies Index (RCSI) is constructed, following Maxwell, Vaitla, Tesfay and Abadi (2013). The RCSI provides information on household behaviour or coping strategies in the presence of food deficits. It is constructed from self-reported practices, including relying on less preferred foods, limiting portion sizes and the number of meals eaten, and reducing meals so as to give priority to children.

For child-level food security, child anthropometric measures are used. The height-for-age z-score (HAZ) compares children's height against global averages for that age (in months). Children's skeletal (linear) growth may be compromised due to constraints to nutrition or health, making HAZ a good indicator of stunting, resulting from long-term or chronic nutritional deprivation. The weight-for-height z-score (WHZ) is also considered. As children suffer thinness resulting from energy deficit and disease-induced poor appetite, or loss of nutrients, the WHZ is a fitting indicator for wasting, or more transitory nutritional deprivation.

Summary statistics

Summary statistics of variables from wave 1 (2010/2011) are provided in the table below. It is noted in the descriptions where averages differ greatly between waves. About 23% of households in the data were in polygynous unions. While the rate of polygyny has been on the decline in recent years, it remains a defining feature of household structure in the Nigerian context (Fenske, 2011). Polygynous and monogamous households differ significantly with respect to participation in formal education and the highest education level attained by any household member, with education levels higher in monogamous households. While only 12% of household members in monogamous households report having no formal education, 21% of members in polygynous households had no education. Additionally, in 33% of monogamous households, the highest educational qualification among members was a secondary school education, compared to only 20% in polygynous households. Across all households, roughly 89% of heads in the sample are employed.

The study sample is predominantly rural, with only about 29% of respondents based in urban areas. Consistent with existing literature, polygyny is predominantly a rural phenomenon; only 16% of polygynous households were based in urban areas, compared with 33% of monogamous households.

Religious dummies were constructed for household heads and it is observed that a majority of polygynous households reported being Muslim; 77% of household heads in polygynous unions are Muslim. The higher proportion of Muslims among polygynous households is not surprising, as Muslim men's right to marry multiple wives is rooted in the Koran. There is, however, a reasonably high incidence of polygyny among Christians also (21% of polygynous households are Christian).

With respect to household composition, the dependency ratio, that is the ratio of children and the elderly to total household members, is higher in polygynous households, as is the number of children below 5 and 15 years of age. Polygynous households have dependency ratios and the number of children under 5 years and under 15 years to be 0.52, 1.74 and 4.72 on average, respectively. Monogamous households have smaller numbers of 0.46, 0.94 and 2.54, respectively. The average household size for polygynous households is 9.43 members, compared to 5.66 members for monogamous households. Finally, polygynous households in the sample were characterized by a higher share of females in the household of 0.53, compared to 0.48 for monogamous households, and the former also had a higher number of adult women in the household, compared to the latter. Thus, while more labor is available in polygynous households, each worker still has on average more members to support.

With respect to household wealth, results indicate that a greater proportion of monogamous households were found in the higher wealth quintiles, compared to polygynous households. Twelve percent of polygynous household belonged to the richest wealth quintile, compared to 24% of monogamous households. Although food and total household expenditures were higher in polygynous, compared to monogamous households, the reverse is true once per capita measurements are employed. In per capita terms, monogamous households had annual food and total household expenditures of $304 and $404, while polygynous households had lower food and total household expenditures of $227 and $277.

There does not appear to be significant differences in livestock ownership, as measured by Tropical Livestock Units (TLUs), or in total land size between polygynous and monogamous households. Using a dummy variable for household experiences of idiosyncratic shocks,[1] it is observed that there were no differences between polygynous and monogamous households in the incidence of shock experience. Finally, polygynous and monogamous households' geographical distribution indicate a prominence of polygynous unions in the northern parts of the country, versus the south, particularly in the north-western zone.

It is observed that polygynous households reported resorting to fewer coping strategies than monogamous households did. As mentioned earlier, these indicators may be limited when it comes to polygynous households, as it is difficult to be certain that any given respondent reports the food security situation for his or her own subfamily unit, or for all members of the household.[2]

T-tests comparing child nutrition outcomes between monogamous and polygynous mothers, and between senior and junior wives indicate that while children of monogamous mothers had better HAZ outcomes than children of polygynous mothers, *within* polygynous households, children of junior wives fared better than children of senior wives (Table 1).

[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, nonfarm business failure, theft of crops, cash or livestock, destruction of harvest, destruction of dwelling.

[2] FCS and RCSIs for other waves shown in Appendix A.

Theory/ calculation

Building directly on the diverse—and often conflicting—findings in the literature, a series of questions and hypotheses related to polygynous family structures and household-level food security outcomes are explored, as well as child-level health outcomes in Nigeria.

Estimation strategy

As mentioned above, it is difficult to make causal claims about the nature of the relationship between polygyny and child health or nutrition outcomes. Descriptive analyses of these relationships are therefore provided, in addition to a series of robust correlations, so as to test the hypotheses about the relationship between food security and polygyny, and elucidate the underlying mechanisms that may be at play.

It may be expected that unobservable household characteristics simultaneously influence a household's propensity to have multiple wives and a household's food security status. That is, there is selection into polygyny on unobservables. A common approach in this case would be to include a household-level fixed effect, since a household fixed-effect may account for these omitted variables, to the extent that these unobservables are time-invariant. However, a fixed-effects model cannot address inter-temporal selection into polygyny based on time-varying unobservables at the household level, nor is it useful for identifying the coefficient of interest on polygyny, which is for the most part time invariant. A random effects model may allow for identification of the coefficient on polygyny, but the essential assumption of a random effects model, that the household-specific random effect is uncorrelated with selection into polygyny and other control variables, is unlikely to hold.

Due to polygyny's limited variation over time, a correlated random effects model (CRE) is estimated at the household level, as an approximation of a fixed effects model that allows the identification of coefficients on time-invariant characteristics. For child-level outcomes, however, a household fixed effects model is employed. Given intra-household variation, coefficients of interest such as mothers' characteristics can be examined, while controlling for all time-invariant household-level traits with the fixed effect.

Hypotheses and specific empirical models are developed below, first for the household-level, and then for the child-level.

Household-level analysis

Four hypotheses are developed regarding the relationship between polygyny and household-level food security:

1. Polygyny has a relationship with food security independently of wealth, household structure, and agricultural livelihood strategy.
2. While household-level wealth should, on average, relate positively to food security as it improves access to food, for polygynous households, the effect of wealth on food security is different than for monogamous households due to different bargaining structures.
3. In polygynous households, the effect of household structure on food security is different than in monogamous households.
4. In polygynous households, the effect of an agricultural livelihood strategy on food security is different than in monogamous households.

To test these hypotheses, a basic CRE model is set out as follows:

$$FS_{ht} = \alpha P_{ht} + \gamma_1 X_{ht} + \gamma_2 \overline{X}_h + \delta T_t + \tau_h + \varepsilon_{ht} \quad (1)$$

In this model, FS_{ht} refers to food security (as measured by FCS and RCSI) for household h at time t and P_{ht} is a dummy variable for whether a household is polygynous ($P_{ht} = 1$) or not ($P_{ht} = 0$). The set of control variables is represented as as X_{ht}, all of which vary across households

Table 1
Summary statistics of household-level variables, by Polygyny: Nigerian general household survey, baseline data, 2011.

	Aggregate sample		Monogamous		Polygynous		T-tests	
	Mean	SD	Mean	SD	Mean	SD	Mono- Poly	
Polygyny	0.225	0.42	–	–	–	–	–	–
Gender of household head (male)	0.999	0.03	0.999	0.04	1	0	-0.00135	(-1.08)
Age of household head	48.813	14.58	48.146	14.8	51.108	13.57	-2.962***	(-5.27)
Highest educational qualification among household members								
No education	0.135	0.34	0.116	0.32	0.207	0.41	-0.0910***	(-6.36)
Basic education	0.337	0.47	0.33	0.47	0.365	0.48	-0.0353	(-1.77)
Secondary education	0.301	0.46	0.325	0.47	0.215	0.41	0.110***	(5.72)
Post-secondary education	0.226	0.42	0.23	0.42	0.214	0.41	0.0163	(0.92)
Household head is employed	0.888	0.32	0.887	0.32	0.891	0.31	-0.00392	(-0.32)
Urban locality	0.294	0.46	0.334	0.47	0.156	0.36	0.177***	(10.22)
Religion								
Household head is Christian	0.481	0.5	0.559	0.5	0.21	0.41	0.349***	(18.89)
Household head is Muslim	0.501	0.5	0.421	0.49	0.777	0.42	-0.356***	(-19.27)
Household Composition								
Dependency ratio	0.479	0.21	0.468	0.21	0.516	0.17	-0.0481***	(-6.08)
Household size	6.511	2.94	5.659	2.21	9.438	3.22	-3.779***	(-39.54)
# household members < 5yrs	1.122	1.17	0.942	0.97	1.739	1.53	-0.797***	(-18.35)
# household members < 15 yrs	3.028	2.23	2.536	1.81	4.719	2.67	-2.183***	(-27.76)
Ratio of female to hh members	0.494	0.16	0.484	0.16	0.53	0.14	-0.0467***	(-7.68)
Adult women (15–65)	1.707	1.03	1.438	0.84	2.63	1.07	-1.192***	(-34.43)
Adult women (> =15)	1.779	1.03	1.506	0.85	2.717	1.07	-1.211***	(-34.75)
Wealth Quintiles								
Poorest wealth quintile	0.208	0.41	0.199	0.4	0.24	0.43	-0.0409**	(-2.61)
Poorer wealth quintile	0.199	0.4	0.182	0.39	0.26	0.44	-0.0789***	(-5.12)
Middle wealth quintile	0.188	0.39	0.177	0.38	0.227	0.42	-0.0497**	(-3.29)
Richer wealth quintile	0.194	0.4	0.206	0.4	0.149	0.36	0.0572***	(3.75)
Richest wealth quintile	0.211	0.41	0.236	0.42	0.124	0.33	0.112***	(7.17)
Per capita food consumption expenditures ($)	286.68	217.03	304.19	230.18	227.07	150	77.12***	(9.14)
Per capita household expenditure ($)	375.35	278.84	404.15	294.72	277.28	185.37	126.9***	(11.79)
Tropical livestock units	24.837	946.44	33.576	1142	5.676	22.31	27.9	(0.60)
Land size (meters square)	441.44	5430	559.30	6337.2	132.59	1180.3	426.7	(1.79)
Idiosyncratic shocks	0.201	0.4	0.198	0.4	0.212	0.41	-0.0135	(-0.87)
Geographical Zones								
North central zone	0.172	0.38	0.161	0.37	0.208	0.41	-0.0467**	(-3.21)
North east zone	0.187	0.39	0.155	0.36	0.297	0.46	-0.142***	(-9.54)
North west zone	0.219	0.41	0.186	0.39	0.333	0.47	-0.147***	(-9.28)
South east zone	0.132	0.34	0.159	0.37	0.038	0.19	0.121***	(9.34)
South west zone	0.154	0.36	0.178	0.38	0.074	0.26	0.104***	(7.47)
South south zone	0.136	0.34	0.161	0.37	0.05	0.22	0.111***	(8.49)
Reduced Coping Strategies Index (0 - 56)	2.14	5.1	2.43	5.5	1.01	2.9	1.198***	(6.63)
Food Consumption Score	53.24	20.19	53.1	19.96	53.77	21.03	-0.0244	(-0.03)
Observations	3839		2974		865		3839	

t-statistics in parenthesis: *p < 0.10,
** p < 0.05.
*** p < 0.01.

and some of which vary across time. Included in this vector are urban locality dummy, household wealth scores, religion dummy for religion of household head, TLU, education, sex and age of household head. This model also includes a vector of within-household averages of all time-varying covariates, $\overline{X}_h$. To the extent that $\overline{X}_h$ is correlated with unobservable household characteristics, a fixed-effect control is approximated. T_t, a term containing the year and region indicator variables and their interactions are added, to account for factors common to all households in a given location and year, such as ecological, economic, or political shocks, or other region-specific time trends. A household random effect τ_h, is included, as well as ε_{ht}, as the idiosyncratic error term for each household and time period.

To test the first hypothesis, (1) is estimated. The coefficient of interest is α, and the anticipated direction of effect is ambiguous. To test the other hypotheses, per capita total consumption W_{ht}; household composition (number of adult women in the household, F_{ht}, dependency ratio indicator, D_{ht}); agricultural livelihood, A_{ht}; and their within-household means are each added in three subsequent specifications. The magnitude or direction of any changes in α are then interpreted.

Child-level analysis

In this section, hypotheses are developed, each building on the previous, related to the relationship between child-level health outcomes and the existing family structure. While it is recognized that selection into polygyny is non-random, it is posited that the key features of selection that would be likely to affect child heath, including household, parent, and child-level characteristics, are captured in this formulation. What unobservable factors may remain manifest as

differences in bargaining power and cooperation, and as such allow us to test the hypotheses. A household fixed effects model is employed in order to explore within-variations at the household level. Regressions are run first, for children of monogamous versus polygamous mothers, and then run for children of senior and junior wives *within* polygynous households.

To test the first hypothesis, the following is run:

$$Y_{iht} = \alpha_1 P^m_{iht} + \gamma_1 M_{iht} + \gamma_2 F_{iht} + \gamma_3 C_{iht} + \gamma_4 X_{ht} + \delta T_t + \mu_h + \varepsilon_{iht} \quad (2)$$

In this formulation, Y_{iht} is the health status (HAZ or WHZ) of child *i*, in household *h,* at time *t*. P^m_{iht} is a binary variable indicating whether the child's mother is in a polygynous union. (In a second set of specifications for *within* polygynous household variations, this represents the senior or junior rank of wives). M_{iht} contains the i^{th} child's mother's age, education, and employment status. F_{iht} contains the *i*th child's father's age, education, and employment status; C_{iht} contains child characteristics such as age and birth order. X_{ht} contains other time-varying household characteristics (dependency ratio, household size, asset index, TLU and idiosyncratic shocks). T_t, is a term containing the year and region indicator variables.

To test the other hypotheses, per capita total consumption W_{iht}; household composition (number of adult women in the household, F_{iht}, dependency ratio indicator, D_{iht}); agricultural livelihood, A_{iht}; and their within-household means are each added in three subsequent specifications. The magnitude or direction of any changes in α are then interpreted.

Results and discussion

Household-level regressions

The results at the household level are presented in Table 2, with a column for the core regression and each step-wise change, and panels for each household-level food security outcome indicator. It is observed first that polygynous households performed better than monogamous households with respect to food security as measured by dietary diversity, with dietary diversity scores on average 2 to 3 points higher for polygynous households with statistical significance at the 1% level. This confirms the initial hypothesis, that there is a relationship between polygyny and household-level food security.

In terms of identifying mechanisms, there are some, though weak, supportive evidence for the posited pathways of wealth, household structure, and agricultural livelihoods. In model two, after inclusion of per capita food expenditures, the coefficient on polygynous household increases and remains significant, indicating that this is not a potential channel of explanation for better food security performance among polygynous households. Controlling for household structure, however, reduced the magnitude of the difference in food security outcomes between monogamous and polygynous households. The implication here is that the household make-up of polygynous households differs from the composition of monogamous households, and those differences at least in small part explain the better dietary diversity outcomes in the former. Polygynous households, for example, have a larger number of adult females, which may serve as useful labor on farms. The inclusion of land size as a proxy for agricultural participation further reduces the magnitude of the polygyny variable, indicating that agricultural participation may also be part of the relationship between food security outcomes and polygyny.

Child -level regressions

The results at the child level are presented in Tables 3a and 3b below. In Table 3a, the results are presented at the individual level, with a column for the core regression and each step-wise change, and panels for each child nutritional outcome indicator. It is observed first that children of polygynous mothers had poorer health than children of monogamous mothers with respect to long-term measures of child nutritional outcomes. This finding contradicts Becker (1981)'s hypothesis that women's welfare might be better when polygyny is practiced. The findings are more in line with Han and Foltz (2015). This confirms the initial hypothesis, that women in monogamous households may enjoy higher bargaining power, which allows them to allocate sufficient resources to their children. In terms of identifying mechanisms, there is little supportive evidence for the posited pathways of wealth, household structure, and agricultural livelihoods.

In Table 3b, results are presented of the effect of wife rank or seniority *within* polygynous households, on child nutrition outcomes. In order to investigate the effect of wife rank on child nutritional status in polygynous households, observations are limited to only children in polygynous households. Consistent with preliminary statistics in Table 3b, children of junior wives are healthier in the long run, compared to children of senior wives. This is consistent with findings by Han and Folt (2015) and Bove, Vala-Haynes and Valeggia (2014) on their examination of polygyny on child nutrition among children in Mali. The finding contradicts Strauss (1990), who found that children of junior wives are more likely to experience stunting and wasting. The finding of better nutritional outcomes for children of junior wives may hint that junior wives may not be as weak, with respect to their bargaining position, as may be expected (Strassmann, 1997).

A reason for this finding of better nutritional outcomes among junior wives may be that junior wives are younger than senior wives. As noted above, younger mothers might have better child birth, and subsequently health outcomes (Rutstein & Winter, 2014). Another explanation proposed by Han and Foltz (2015) is that marriage to a first wife is usually arranged by the parents, with men having greater influence in choosing additional wives. Therefore, polygynous husbands may prefer, and thus allocate, more resources to (more favoured) junior wives of their own choosing. Furthermore, since senior wives and their offspring had a period of time to enjoy household resources exclusively until such a time as an additional wife is brought into the household by her husband, junior wives might be able to persuade their husbands that it is "their turn" to benefit from household resources. Sellen (1999) also proposes that children of lower ranking ranks may be better off if these women are entering the marriage under more favorable or prosperous circumstances.

Conclusions

In this study, a series of questions and hypotheses related to polygynous family structures and both household and individual-level food security outcomes were explored. These questions were examined using three rounds of World Bank Living Standards Measurement Survey data from Nigeria, collected from 2011 to 2014. Analyses at the household level involved the use of a correlated random effects model while a household fixed effects model was employed for the individual level analyses.

Although the results of household-level regressions suggested that polygyny has better implications for food security, the results of the household level regressions should be interpreted with caution, given the noted limitation of the data collection process on food security. Individual level regressions indicated that better child nutrition outcomes were found in monogamous households, compared to polygamous households. Within polygynous households, it was found that children of junior wives had better long term nutritional outcomes, compared to children of senior wives.

There are other important results from the analyses- wealth and livestock ownership are positively associated with food security at the

Table 2
Testing the various hypotheses- regression estimates of polygyny in Nigeria (2010/11, 2012/13 and 2014/15 waves).

Dependent Variables:	Food Consumption Scores				Reduced-Coping Strategies Index			
Hypotheses:	1	2	3	4	1	2	3	4
Per Capita Expenditure		0.00	0.00	0.00		-0.00	-0.00	-0.00
		(0.30)	(0.09)	(1.09)		(-0.63)	(-0.44)	(-0.84)
Dependency ratio			2.12	4.06*			1.21*	1.08
			(1.00)	(1.74)			(1.93)	(1.53)
# Adult women			-0.39	0.10			0.14	0.06
			(-0.93)	(0.22)			(1.21)	(0.47)
Household size			-0.03	-0.41			0.01	0.02
			(-0.11)	(-1.20)			(0.16)	(0.19)
Land size (logged)				-0.19*				0.10**
				(-1.67)				(2.37)
Polygyny	2.85***	3.23***	2.90***	2.94***	0.11	0.11	-0.07	0.04
	(4.73)	(5.28)	(4.07)	(3.86)	(0.73)	(0.73)	(-0.39)	(0.22)
Male head	1.90	0.82	0.91	-0.51	-1.21	-1.25	-1.24	-1.04
	(0.89)	(0.36)	(0.40)	(-0.22)	(-1.17)	(-1.15)	(-1.14)	(-0.71)
Age of Head	-0.06	-0.06	-0.06	-0.09*	-0.01	-0.01	-0.01	-0.01
	(-1.34)	(-1.30)	(-1.35)	(-1.65)	(-0.97)	(-0.46)	(-0.71)	(-0.46)
Education (no education is base)								
Basic	-0.64	-0.90	-0.82	-1.12	0.18	0.20	0.22	0.03
	(-0.68)	(-0.95)	(-0.87)	(-1.14)	(0.66)	(0.76)	(0.81)	(0.11)
Secondary	0.13	-0.22	0.01	-0.57	0.30	0.40	0.43	0.33
	(0.12)	(-0.21)	(0.01)	(-0.50)	(0.96)	(1.24)	(1.33)	(0.96)
Post-secondary	0.10	-0.38	-0.09	-0.18	-0.18	-0.10	-0.07	-0.18
	(0.08)	(-0.32)	(-0.07)	(-0.14)	(-0.55)	(-0.30)	(-0.20)	(-0.54)
Muslim head	-45.01***	-43.17***	-42.96***	-42.81***	-1.12	-1.28	-1.33	0.99
	(-7.01)	(-5.88)	(-5.91)	(-5.72)	(-0.55)	(-0.63)	(-0.63)	(0.43)
Urban	6.05	8.17*	7.91*	4.93	-1.48*	-1.26	-1.29	1.16*
	(1.51)	(1.86)	(1.80)	(0.69)	(-1.65)	(-1.30)	(-1.36)	(1.86)
Wealth scores	0.70***	0.58**	0.60**	0.49*	-0.35***	-0.31***	-0.31***	-0.25***
	(2.97)	(2.38)	(2.45)	(1.73)	(-5.06)	(-4.36)	(-4.32)	(-2.94)
Tropical livestock Units	0.00	0.00	0.00	0.00	-0.00***	-0.00***	-0.00***	-0.00***
	(0.36)	(0.35)	(0.34)	(0.31)	(-4.81)	(-4.23)	(-4.13)	(-3.75)
Shocks	0.48	0.55	0.52	0.92	0.81***	0.85***	0.85***	1.14***
	(0.62)	(0.71)	(0.66)	(1.09)	(3.41)	(3.48)	(3.48)	(4.24)
Zonal Controls	YES	YES	YES	YES	YES	YES	YES	YES
Wave control	YES	YES	YES	YES	YES	YES	YES	YES
Zone*Wave Interactions	YES	YES	YES	YES	YES	YES	YES	YES
R^2- Within	0.02	0.02	0.02	0.03	0.12	0.12	0.12	0.13
R2- Between	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.27
R2- Overall	0.14	0.15	0.15	0.14	0.20	0.20	0.20	0.23
# of Observations	6793.00	6568.00	6568.00	5437.00	6796.00	6569.00	6569.00	5449.00

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

household level, while the presence of economic shocks is negatively correlated. At the child level, the age of mothers, higher mothers' education and livestock ownership are all positively associated with child nutrition. From a policy perspective, these findings may indicate a need for greater emphasis on higher education, in addition to the creation of employment opportunities, in order to improve the wealth status of households in the country and increase nutrition status of children. The presence of economic shocks is also associated with poorer food security outcomes at the household level, indicating the need for social interventions and safety-net programmes to mitigate the adverse effects of shocks on food security of families in Nigeria.

There are a number of calls to ban the practice of polygyny either to protect women's rights, or to foster a country's development (Tertilt, 2005; Gould, Moav & Simhon, 2008). Indeed, polygyny is banned in a number of developed and developed countries, although the practice still exists. The present study sought to provide empirical evidence of the correlation between this practice and household and child welfare outcomes. Although positive effects of polygyny were initially observed at the household level, these findings are not observed at the more critical individual level (better child nutrition outcomes were found in monogamous households, compared to polygamous households), raising some concerns about potential negative effects of polygyny on child welfare outcomes in Nigeria.

Table 3a
Household fixed effects regressions of child health outcomes on polygyny- Nigerian general household survey (2010/11, 2012/13 and 2014/15).

Hypotheses	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	Height-for-Age				Weight-for-Height			
Mother is polygynous	-1.66*	-1.87**	-2.49***	-2.42**	0.68	0.69	0.76	0.96
	(-1.93)	(-2.10)	(-2.64)	(-2.48)	(0.88)	(0.87)	(0.90)	(1.10)
Mother's age	0.08**	0.07**	0.08**	0.08**	-0.01	-0.01	-0.01	-0.03
	(2.49)	(2.46)	(2.51)	(2.42)	(-0.53)	(-0.54)	(-0.56)	(-0.92)
Education (no education is base)								
Basic	-0.83	-0.86*	-0.96*	-0.97*	1.00**	1.00**	0.97**	1.00**
	(-1.63)	(-1.69)	(-1.88)	(-1.86)	(2.29)	(2.28)	(2.19)	(2.21)
Secondary	-1.71***	-1.76***	-1.79***	-1.70***	0.91*	0.91*	0.92*	0.88
	(-2.79)	(-2.86)	(-2.91)	(-2.67)	(1.73)	(1.72)	(1.73)	(1.62)
Post-secondary	-0.92	-1.02	-1.16	-1.21	1.20*	1.20*	1.14*	1.13
	(-1.17)	(-1.28)	(-1.47)	(-1.48)	(1.82)	(1.81)	(1.70)	(1.64)
Mother is employed	0.05	0.07	0.04	0.11	0.27	0.27	0.30	0.31
	(0.13)	(0.19)	(0.12)	(0.29)	(0.92)	(0.91)	(0.99)	(0.99)
Fathers age	0.03	0.03	0.02	0.01	-0.08**	-0.08**	-0.08**	-0.06*
	(0.67)	(0.73)	(0.37)	(0.26)	(-2.27)	(-2.26)	(-2.20)	(-1.65)
Education (no education is base)								
Basic	0.08	0.10	0.11	0.16	0.02	0.02	0.05	0.06
	(0.18)	(0.23)	(0.25)	(0.34)	(0.06)	(0.06)	(0.14)	(0.16)
Secondary	0.19	0.26	0.31	0.25	-0.01	-0.01	0.02	0.07
	(0.31)	(0.41)	(0.49)	(0.37)	(-0.02)	(-0.02)	(0.03)	(0.12)
Post-secondary	0.50	0.57	0.65	0.83	-0.76	-0.76	-0.68	-0.82
	(0.58)	(0.66)	(0.75)	(0.90)	(-1.01)	(-1.01)	(-0.89)	(-1.02)
Father is employed	0.77	0.69	0.68	0.75	0.79	0.80	0.84	0.77
	(1.16)	(1.04)	(1.02)	(1.04)	(1.45)	(1.45)	(1.51)	(1.30)
Muslim head	1.14	0.94	0.81	0.54	-3.23	-3.22	-3.03	-4.63*
	(0.51)	(0.42)	(0.36)	(0.20)	(-1.65)	(-1.63)	(-1.51)	(-1.93)
Child age	-0.12*	-0.13*	-0.15**	-0.12	0.06	0.05	0.04	0.02
	(-1.66)	(-1.75)	(-2.01)	(-1.59)	(0.88)	(0.84)	(0.63)	(0.26)
Child birth order	-0.13	-0.14	-0.17*	-0.13	-0.05	-0.05	-0.07	-0.09
	(-1.41)	(-1.45)	(-1.67)	(-1.26)	(-0.61)	(-0.59)	(-0.80)	(-1.03)
Urban	-3.27	-1.69	-1.68	1.79	1.77	1.69	1.79	0.40
	(-1.28)	(-0.56)	(-0.56)	(0.73)	(0.79)	(0.63)	(0.67)	(0.18)
Shocks	0.26	0.27	0.31	0.32	-0.22	-0.22	-0.25	-0.37
	(0.65)	(0.68)	(0.79)	(0.77)	(-0.68)	(-0.68)	(-0.77)	(-1.08)
Tropical Livestock	0.03	0.03	0.01	0.02	-0.02	-0.02	-0.03	-0.03
	(0.75)	(0.68)	(0.36)	(0.53)	(-0.64)	(-0.63)	(-0.75)	(-0.92)
Wealth scores	-0.01	-0.00	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01
	(-0.12)	(-0.04)	(-0.13)	(-0.14)	(-0.15)	(-0.15)	(-0.21)	(-0.12)
Per capita expenditure		-0.73	-0.56	-0.73		0.04	-0.14	-0.18
		(-0.95)	(-0.72)	(-0.89)		(0.06)	(-0.21)	(-0.25)
Dependency ratio			-2.50	-2.04			-2.16	-2.40
			(-1.30)	(-1.01)			(-1.27)	(-1.35)
Household size			0.21	0.11			-0.02	-0.05
			(1.11)	(0.53)			(-0.14)	(-0.27)
# of Adult women			0.30	0.25			-0.19	-0.23
			(0.92)	(0.74)			(-0.67)	(-0.79)
Land size (logged)				-0.03				-0.02
				(-0.52)				(-0.40)
Zonal controls	YES	YES	YES	YES	YES	YES	YES	YES
Wave control	YES	YES	YES	YES	YES	YES	YES	YES
Zone*Wave controls	YES	YES	YES	YES	YES	YES	YES	YES
Household dummies	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.74	0.74	0.74	0.73	0.70	0.70	0.70	0.68
N	1078.00	1065.00	1065.00	919.00	1112.00	1100.00	1100.00	952.00

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

Table 3b
Household fixed effects regressions of child health outcomes on wife seniority- Nigerian general household survey (2010/1, 2012/13 and 2015/16).

Hypotheses	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	Height-for-Age				Weight-for-Height			
Mother is Senior wife	-0.72**	-0.76**	-0.78**	-0.86**	0.07	0.05	0.05	0.12
	(-2.03)	(-2.12)	(-2.17)	(-2.15)	(0.29)	(0.19)	(0.21)	(0.42)
Mother's age	0.06*	0.06**	0.06**	0.07**	-0.00	-0.00	-0.00	-0.03
	(1.96)	(2.00)	(2.04)	(2.09)	(-0.03)	(-0.02)	(-0.15)	(-0.97)
Education (no education is base)								
Basic	0.06	0.06	0.01	0.12	0.29	0.32	0.30	0.45
	(0.12)	(0.12)	(0.02)	(0.20)	(0.82)	(0.89)	(0.84)	(1.08)
Secondary	0.50	0.53	0.52	1.35	0.13	0.14	0.07	-0.29
	(0.74)	(0.78)	(0.75)	(1.57)	(0.28)	(0.29)	(0.13)	(-0.49)
Post-secondary	2.00**	1.98**	1.97**	2.36**	-0.58	-0.56	-0.68	-0.67
	(2.37)	(2.33)	(2.26)	(2.31)	(-0.97)	(-0.94)	(-1.12)	(-0.96)
Mother is employed	0.14	0.22	0.29	0.10	0.07	0.04	0.01	0.11
	(0.32)	(0.48)	(0.63)	(0.20)	(0.21)	(0.13)	(0.03)	(0.32)
Fathers age	0.01	0.01	0.03	0.04	0.00	0.00	-0.01	-0.02
	(0.23)	(0.20)	(0.58)	(0.65)	(0.06)	(0.05)	(-0.32)	(-0.51)
Education (no education is base)								
Basic	0.32	0.42	0.20	-0.22	-0.29	-0.34	-0.14	-0.22
	(0.50)	(0.64)	(0.29)	(-0.29)	(-0.66)	(-0.74)	(-0.31)	(-0.43)
Secondary	-0.63	-0.65	-0.59	-1.19	2.15***	2.15***	2.17***	2.68***
	(-0.59)	(-0.60)	(-0.54)	(-1.00)	(2.80)	(2.79)	(2.81)	(3.23)
Post-secondary	-0.31	-0.50	-0.85	-0.66	-0.03	0.05	0.01	-0.40
	(-0.24)	(-0.39)	(-0.64)	(-0.42)	(-0.04)	(0.05)	(0.01)	(-0.37)
Father is employed	1.98*	1.94	1.82	2.34	0.76	0.73	0.32	0.38
	(1.65)	(1.61)	(1.34)	(1.59)	(1.10)	(1.05)	(0.40)	(0.46)
Muslim head	0.40	1.24	-0.58	-0.17	-0.72	-1.06	0.79	1.06
	(0.15)	(0.44)	(-0.16)	(-0.04)	(-0.37)	(-0.52)	(0.31)	(0.39)
Child age	0.04	0.03	0.01	-0.08	0.01	0.01	0.03	-0.02
	(0.29)	(0.23)	(0.08)	(-0.48)	(0.08)	(0.08)	(0.33)	(-0.18)
Child birth order	-0.13	-0.13	-0.18	-0.23	-0.10	-0.10	-0.04	-0.10
	(-0.64)	(-0.66)	(-0.88)	(-0.98)	(-0.70)	(-0.69)	(-0.24)	(-0.64)
Urban	-0.53	-2.05	-2.24	-1.62	0.44	1.02	1.42	1.01
	(-0.21)	(-0.70)	(-0.76)	(-0.52)	(0.28)	(0.54)	(0.75)	(0.51)
Shocks	0.82	0.70	0.69	0.95	0.26	0.30	0.42	0.22
	(1.45)	(1.19)	(1.15)	(1.43)	(0.64)	(0.73)	(0.99)	(0.49)
Tropical Livestock	0.22*	0.20*	0.24**	0.28**	0.22**	0.23**	0.22**	0.18
	(1.95)	(1.72)	(2.00)	(2.07)	(2.18)	(2.24)	(2.13)	(1.56)
Wealth scores	-0.36**	-0.33*	-0.36**	-0.36*	-0.23*	-0.25*	-0.26**	-0.13
	(-2.12)	(-1.93)	(-2.03)	(-1.87)	(-1.87)	(-1.93)	(-2.00)	(-0.93)
Per capita expenditure		-1.35	-1.15	-0.81		0.54	0.29	0.16
		(-0.99)	(-0.83)	(-0.55)		(0.58)	(0.31)	(0.16)
Dependency ratio			2.54	1.26			-2.97	-3.80
			(0.73)	(0.34)			(-1.22)	(-1.49)
Household size			0.11	0.16			-0.25	-0.10
			(0.40)	(0.46)			(-1.27)	(-0.40)
# of Adult women			0.49	0.47			-0.00	0.07
			(0.89)	(0.78)			(-0.01)	(0.17)
Land size (logged)				-0.01				0.02
				(-0.05)				(0.23)
Zonal controls	YES	YES	YES	YES	YES	YES	YES	YES
Wave control	YES	YES	YES	YES	YES	YES	YES	YES
Zone*Wave controls	YES	YES	YES	YES	YES	YES	YES	YES
Household dummies	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.69	0.69	0.69	0.71	0.76	0.76	0.77	0.77
N	531.00	524.00	524.00	454.00	552.00	545.00	545.00	473.00

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

Conflicts of interest

None.

Appendix A. Measures of household food security indicators, by Wave (Nigerian General Household Survey)

Wave 1 (Full Sample)			Wave 2 (Full Sample)			Wave 3 (Full Sample)		
Mean	SD	Difference (T-tests)	Mean	SD	Difference (T-tests)	Mean	SD	Difference (T-tests)
Reduced coping strategies index								
2.14	5.1	1.198*** (6.63)	3.21	6.05	1.47*** (6.53)	3.85	5.97	0.82*** (3.62)
Food consumption score (dietary diversity)								
53.24	20.19	0.0244 (0.03)	51.89	20.01	-2.71*** (-3.61)	52.35	19.92	0.37 (0.49)

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