

# **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.

## I. INTRODUCTION AND MOTIVATION

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 (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 an 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, nd).

The current research focuses on family structure and food security in Nigeria, and in particular on the possible influence of polygyny, the still common practice of a man marrying more than one wife, on both household and child-level outcomes. While more wives means more potential caregivers and this may engender better food security outcomes, the presence of multiple wives may engender competitive rather than cooperative strategies, making the relationship between polygyny and food security ambiguous. Within polygynous households, the relationships and bargaining outcomes between co-wives may in turn systematically relate to different outcomes for children of senior versus junior wives.

Despite the extraordinary importance of issues of food security in Nigeria, the subject area remains poorly-understood and sparsely researched in large part due to the complexity of the problem. Additionally, the data needed to assess the determinants of food security in a nuanced manner across the entire country, and at the individual level are rarely available. Where nationally representative data is available, these often do not include food and nutrition indicators, particularly at the individual level. Data sets that do contain food security indicators are not often nationally representative and instead focus on small geographical areas, or districts (e.g. Abimbola & Adejare, 2013; Atoloye, Olubukola & Folake, 2015).

This paper explores the relationship between polygyny 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.

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 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.

## **II. BACKGROUND**

### **a. Correlates of Polygyny**

A number of factors are correlated both with the societal prevalence of polygyny and the likelihood that men and women join in polygynous unions. Religion and culture are often important factors. While most Christians customarily discourage the practice, most Muslims allow or encourage it (Boserup, 1970), although some Muslim countries like Turkey and Tunisia do not encourage the practice. Ethnicity can also play an important role, as different groups have different values and traditions, both related to and independent of religious traditions, and may also have differential exposures to the effects of modernization. In Nigeria, Hausa women, commonly found in the Northwest region of the country, are more likely to be in polygynous union, compared to other ethnic groups, including Yorubas. These ethnic divides are highly, but not perfectly, correlated with the Muslim-Christian religious divide, and cross-ethnic marriage is also common (Kritz & Makinwa-Adebusoye, 1995).

Economic conditions, including wealth and livelihood activities, are also potentially highly related to polygyny. Polygyny is less prevalent, for example, in urban areas, given the higher cost of living and raising children, as well as the lack of farming opportunities, which can decrease the potential value-added of additional household labor (Maillu, 1988). The level of household wealth can be both cause and consequence of polygyny (Timaeus & Reynar, 1998). On the one hand, wealthier men are able to afford more wives as they are more likely to be able to provide for them; on the other hand, polygyny may increase men's access to land and labour from women and children, leading to higher production and higher wealth. This latter phenomenon is more likely to hold in agricultural communities (Mair, 1971).<sup>1</sup>

Finally, engaging in polygyny can be related to individual characteristics and experiences, particularly for women. Education plays a particularly important role; using demographic and health survey data for women in sub-Saharan Africa, Hayase and Liaw (1997) found that the transition of women from secondary to higher education results in a significant reduction in their likelihood of engaging in polygynous unions. This trend may relate to exposure through the formal education system to

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<sup>1</sup> In the present study, the highest concentration of polygynous households is, indeed, found in the north west (*see Table 2*)

Western cultures, in which monogamous unions are the norm and polygyny is frowned upon or even illegal. Age is also a factor; older women are more likely to be in polygynous unions for two reasons; first, given the increasing effects of modernization, younger cohorts may be less likely to be in polygynous unions. According to the 2013 Nigerian Demographic and Health Survey, the proportion of women in polygynous unions increases with age, and this is mostly attributable to the Islamic religion and the prevailing culture which allows a man to have more than one wife. The age at which a woman gets married may also affect the nature of her union. On the one hand, a woman who marries at a very young age may become likely to be in a polygynous union later in her life. On the other hand, women who marry at later ages may agree to be second wives, as they are willing to marry into polygynous unions, in order to avoid the social stigma of not being married (Hayase & Liaw, 1997).

#### **b. Motivations and Consequences of Polygyny**

In Nigeria, roughly a third of all married women are in polygynous unions (NDHS, 2008). While under the increasing influence of Westernization and modern attitudes, the traditional patriarchal system dominates, which is related to the higher rate of polygyny (Asinyanbola, 2005). The effects of gender asymmetry with respect to social and cultural rights and responsibilities within the patriarchal system are also readily observed in practices such as defined gender roles. In keeping with these traditional roles, men are typically the heads of families while females are involved in domestic chores and child rearing. With respect to agricultural activities, men are traditionally responsible for land preparation activities while women plant and harvest the crops. Polygynous households are therefore able to cultivate larger plots of land, given the labour supply and greater cultivation activities by co-wives (Asiyanbola, 2005). Therefore, despite the potentially thinner distribution of resources among many family members, the net gain could be positive, due to economies of scale.

Nigerian society places significant emphasis on having children, which constitutes a major motivation for marriage, often leading to early marriage and pregnancy, particularly in the rural and northern parts of the country (Isiugo-Abanihe, 1994). On average, polygyny leads to a larger number of children in the household, which conforms with social expectations and also increases a man's social status within his community. According to Isiugo-Abanihe (1994), even a man who is not well-endowed financially is regarded with more respect if he has many children.

The motivation for polygyny differs between men and women, and may have differential implications for welfare on women and men. The literature on the effects of polygyny on women's welfare is mixed. Some researchers argue that polygyny is beneficial to women (Becker, 1981; Grossbard, 1980) while others find negative outcomes among women engaged in these unions (Ickowitz & Mohanty, 2015; Bergmann, 1995). Proponents of polygyny argue that women in polygynous unions tend to benefit from increased consumption after marriage due to access to husband's resources and her bride price that is received, and also from labour sharing among co-wives with respect to domestic work, agricultural responsibilities, or child care duties, resulting in increased leisure time.

According to Becker (1981), women in polygynous unions are likely to fare better than women in monogamous unions. This conclusion is based on the assumption that there are fewer men on the marriage market than women. While data on Nigerian population and demography indicates a slightly higher proportion of males than females in general, the proportion of females in the youth category (15-

39 years) is smaller than the proportion of males in this category (National Bureau of Statistics, 2016). A polygamist regime might therefore increase the supply of men through increased demand for brides. This higher demand for women would therefore raise the price of women and result in their higher access to marital income and consumption. However, many disagree with these conclusions. For instance, women in polygynous unions may not be better off than their monogamous counterparts if ceilings are placed on access to marital income. The presence of price ceilings on the consumption of women in polygynous unions is likely to result from the situation where marriage gives men some legal control over the distribution of marital products. Men may then use this power to place restrictions on women's access to marital income, even when a woman's price in a marriage may be higher, as is proposed to be the case under polygyny (Grossbard, 2014).

In the African context, polygyny may indeed be beneficial to women in some societies given that polygynous husbands tend to be wealthier and the pool of laborers available for domestic work from the larger number of wives reduces the need for wage laborers (Adams & Mburugu, 1994; Dorjahn, 1988). According to Ware (1979), approximately 60% of Yoruba women in Nigeria preferred to be in a polygynous union because it would provide both a social opportunity to interact, as well as provide help with the domestic work. However, given the period under study, it is important to note that present conclusions may differ.

However, opponents of polygyny cite co-wife conflict and oppression as negative effects on women. In the African context, there may be challenges with the arrival of a new wife. This is because of the fear that additional wives would reduce the availability of household material resources, take away the husband's time and also his affections and availability (Adams & Mburugu, 1994; Ware, 1979). The presence of these fears or perceptions of threats may give rise to envy and jealousy between co-wives, leading to conflict (Eichenbaum & Orbach, 1988; Potash, 1995). In addition to the possibility of a lower level of consumption and higher conflict situations among women in polygynous unions, the view of polygyny as a tool for the oppression of women is of graver concern (Ickowitz & Mohanty, 2015). Indeed, Ickowitz and Mohanty (2015) found that women in polygynous unions in Ghana are often more likely to experience domestic violence, and have lower decision-making power, compared to women in monogamous unions.

With respect to their welfare, men are likely to benefit from polygyny as a result of the traditional system of agriculture, which prevails in rural areas and in the northern regions of Nigeria. Where farming and pastoralism are common, having more labour available at the household level from wives and children can increase agricultural production. Similarly, for women, the presence of additional wives may lead to shared responsibilities and hence increased leisure time (Ware, 1979). Where these relationships are of primary importance, it is expected that polygynous households would have better agricultural and food security outcomes. Although polygyny is more popular in rural areas where there is more potential for economic benefits, it is often practiced in urban areas in Nigeria as well. The motivation for this practice in urban areas appears to be more related to associated social prestige, given that a large family is symbolic of wealth in the Nigerian context (Naksomboon, 2013).

### **c. Polygyny and Food Security**

The question of how polygyny affects the distribution of power and subsequent household welfare has been explored. Anderson et al. (2016), for example, found that while women in monogamous households have more decision-making authority than women in polygynous households, this perception differs between husbands and co-wives in polygynous households; while women in polygynous households report having less authority, their husbands do not appear to feel the differences in the share of household decision-making as strongly. The authors also find that women tend to have differential levels of bargaining power over particular kinds of decisions within the household.

A number of factors are highlighted as important determinants of women's bargaining authority within the household, such as her level of education, income-earning capacity, and socio-cultural norms. Within polygynous households, however, there are some additional complexities in the bargaining process. Different researchers have found evidence for both co-operation and competition among co-wives in polygynous households.

Akresh et al. (2012) highlight the role of co-wife cooperation within polygynous households in Burkina Faso, where cooperation among wives is measured by agricultural yield differentials. Where wives cooperate with each other, but with not their husbands, their yields are higher than that of their husband. 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 (2006) 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 et al. (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.

Where there is cooperation, polygynous households may benefit greatly from labour sharing; the large pool of labour from women and children in the household may potentially increase the over-all wealth and food supply (Boserup, 1970; Zietzen, 2008). This supposition would be most applicable in households engaged in labor-intensive agriculture. Higher rates of school attendance, particularly by girls, may induce household labor shortages, which could provide still another incentive for co-wives to cooperate (Nasimiyu, 1985). All of these findings point to ambiguous effects of polygyny on household level measures of food security.

It is expected that household size and structure would be positively related to food security outcomes where there are scale economies associated with number of household members. At the same time, if larger household size induces more competition for resources, this could result in uneven or thinner distribution of resources across household members. For instance, investments in children may fall with larger family sizes (Heer, 1985; Maitra & Pal, 2008). On the other hand, some earlier research indicates that children may on net contribute to household resources (Gomes, 1984; Chernichovsky, 1985). Beyond scale economy and resource dilution effects of household size, it may be expected that the relationship between the adult household members (that is, whether they are married to the same person or not) would be related to the efficiency of the household. In a household where there are multiple co-wives, cooperation or competition might either enhance or undermine the efficiency gains of larger household size relative to a household with multiple females who are not all married to the same person.

#### **d. Child Health Outcomes and Polygyny: Intra-household bargaining effects**

Polygyny may have implications for both women and children's well-being, as a number of studies have found that women in polygynous marriages had poorer welfare outcomes, as measured by mental and psychological statuses. Sellen (1999) also found that anthropometric outcomes of both women and children worsened under polygynous regimes in Tanzania. Interestingly, he found that children of both first and second wives were worse off under polygyny, than other lower-order wives, attributing this to these women entering the marriage under more favorable or prosperous circumstances. Arney (2002) found that there were higher risks of child mortality in polygynous, compared to monogamous households, using Demographic and Health survey data from 6 countries in West Africa. Kazinaga and Klonner (2009) also found evidence of higher child mortality risks in polygynous households in rural Mali. Hadley (2005) found that children of polygynous households had poorer outcomes, as measured by their nutritional status and growth outcomes in Tanzania. Wagner and Rieger (2015) used demographic and health data for 26 African countries and household fixed effect models and found that children of monogamous households had better long term nutritional outcomes than children of polygynous households. Additionally, children of junior wives had worse outcomes than children of senior wives. These studies appear to consistently suggest that polygamy is adversely related to both women and children's welfare, although seniority within a polygamous household may be advantageous.

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. The relationship between polygyny and individual children's health outcomes most likely operates through the efficiency channels described above, 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).

It is important to note that selection into polygynous unions is non-random, and therefore, women in monogamous unions may have systematically different characteristics than women in polygynous unions, which independently affect their bargaining power and children's wellbeing. Women's higher bargaining power within monogamous households may thus be linked to observable characteristics, such



as education, income-earning capacity, and productivity, as well as unobservable characteristics (Amankwaa, 1996; Doss, 2013). Given their higher bargaining power, higher share of household production and women's general proclivity to readily apply resources towards household welfare goals such as food, clothing and health, children of monogamous women may fare better than their polygynous counterparts with regards to food security (Haddad, Hoddinott, & Alderman, 1997; Thomas 1997; Quisumbing & Maluccio 2003). To the extent that monogamous women have greater autonomy to allocate resources, they can better weight the costs and benefits of alternative uses of household resources to assure the most efficient outcomes (Smith, 1995). To the degree that polygyny increases efficiency and allows access to more resources, and if those resources are pooled among wives (Akresh, Chen & Moore, 2016), children of women in polygynous households may be expected to exhibit better health outcomes. If resources are not fully pooled (that is, there is not full cooperation between wives), then children of women in polygynous unions may exhibit the same or worse health outcomes as children in monogamous households.

**e. Child Health Outcomes in Polygynous Households: Does wife status matter?**

Bargaining power differentials between mothers within polygynous households may also contribute to uneven health outcomes among children. Evidence suggests that senior wives may have greater bargaining power, through which their children could have better outcomes. According to Leith-Ross (1965), among the Igbo tribe in Nigeria, intra-household power can stem from the senior wife assisting the husband in the payment of the bride price for the junior wife. Additionally, among the Nigerian Igbo, a woman may consider her position as a sole wife humiliating and urge her husband to take on additional wives so as to provide assistance with farm labor activities (Basden, 1938). Despite the presence of additional wives, the senior wife may retain her higher bargaining position and control over household resources, if culturally, first wives are regarded highly among junior wives as is the case among the Nigerian Yoruba (Bascom, 1942). An exception to this is among Muslim communities where one wife cannot claim seniority over other wives, given that Islam prescribes that husbands treat all wives equally (Boserup, 1970). This religious prescription against seniority among wives may not, however, always be the case in practice. Even where husbands do treat their wives equally, this may not necessarily eliminate the possibility of intra-household bargaining among wives, because women's assets and contributions to the household (that is, their bargaining power sources) may not be completely determined by their husband's treatment of them.

Another reason that children of senior wives may have better child health outcomes than those of junior wives could be that senior wives may have had more time to accumulate resources either through the establishment of work opportunities or through savings. According to Uchendu (1965), the presence and support of junior wives in Nigeria frees up senior wives and allows them to engage in other income-earning activities such as trading. Even in situations where junior wives are not yet present in the household, but the incidence of polygyny in the community is high, a senior wife, in anticipation of this potential negative income shock, may begin saving and accumulating personal resources, which may be used for the benefit of children in the future (Bolt & Chort, 2015). These resources may benefit children directly through spending on their expenses, and indirectly through increased bargaining power over time and other resources.

A mother's characteristics and experiences might affect her children's health, however, and these characteristics may also be systematically related to a mother's status as a senior or junior wife. For example, junior wives may be healthier, better educated, or otherwise more able to bear and care for children. A man may be likely to take on additional wives when he becomes wealthier, at which point he may select more successful and productive wives through assortative matching (Grossbard, 1980). The presence of these high-quality wives may, however, lead to fewer co-wives in the future, if they have greater bargaining power and are able to resist their husbands taking on additional wives (Grossbard, 1980).

Wives are also likely to be different in age, and if a husband marries a junior wife who is of an optimal reproductive age, this may have positive and better outcomes for her child's nutrition, compared to older senior wives. Women of childbearing age with relatively lower ages at their first birth tend to be associated with better child nutritional status (Rutstein & Winter, 2014). This would not be the case, however, in instances where men marry divorced or widowed women, such as in Sudan, where a widow is re-married by one of the brothers of her deceased husband, in order not to waste her procreative abilities (Beswick, 2001).

### **III. DATA AND DESCRIPTIVE STATISTICS OF KEY STUDY VARIABLES**

The study employs nationally-representative data from the Nigerian General Household Survey (GHS), containing information collected from 5,000 households. 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 module, which includes information on demographics, education, health, food security, and economic shocks, among others.

The data consists of three waves, 2010/2011, 2012/2013 and 2014/15<sup>2</sup>, and each wave consists of two seasons, post-planting and post-harvest. The post-planting data was collected directly after the planting season to collect information on the preparation of plots, inputs used, labour used for planting and other issues related to the planting season. The post-harvest data was collected after the harvest season and included information on crops harvested, labour used for cultivating, harvest activities, and other issues related to the harvest cycle. 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

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<sup>2</sup> A third wave of the data is available but does not include consumption aggregates and therefore, these measures are employed from the earlier wave

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.

Summaries of the variables used are provided, including key control variables and the outcomes of interest. These descriptions are divided along the lines of key features of family structure—either polygynous or not, at the household level, and the status of the mother in polygynous households, at the child level. Appendix 1 describes the key control variables used, and how they are constructed.

Polygyny, as the main explanatory variable of interest, is constructed from the number of wives present in the household roster. Self-reported information on marital status are not utilized, as in the data we observed that some individuals reported being in a polygynous union while there was only one spouse present in the household, and men and women reported differential marital status (polygynous versus monogamous). As mentioned above, there may also be the case of co-wives who lived away from a specified household. As the focus of the study is specifically about bargaining over food and other resources on site, the study uses “observed” polygyny, the case in which multiple wives of the same husband are in fact present in the household.

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, Basset, Benson and 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, and in practice, a score less than 21 is considered poor, 21 to 35 is borderline, and above 35 is considered acceptable. 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. The index is a combination of these practices and their frequencies in the prior week, such that a higher score is an indication of greater food insecurity. In practice, scores of 0 to 4 are considered food secure while scores of greater than 20 are considered very food insecure.

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.

**a. Summary Statistics**

Summary statistics of variables from wave 1 (2010/2011) are provided in the tables below. It is noted in the descriptions where averages differ greatly between waves. The descriptive statistics are presented as follows: Table 1 presents summary statistics of household level controls, including education, wealth, socioeconomic and geographical characteristics in the post-harvest season, with information on education and religion updated from the post-planting season. Table 2 summarizes food security indicators at the household level for the post-harvest season. Table 3 presents descriptive statistics of two measures of child nutritional outcomes, by bivariate comparisons of polygyny (that is, monogamous versus polygynous wives; senior versus junior wives) for waves 1 and 2. Finally, Table 4 summarizes characteristics of mothers in polygynous versus monogamous marriages, mothers who are senior versus junior wives in polygynous unions, and fathers in polygynous versus monogamous marriages, in the first wave of the survey.

**i. Table 1- Household Level Variables, by Family Structure: Nigerian General Household Survey, Baseline data, 2011**

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. This might lead to better outcomes among monogamous households, given that higher formal education may be correlated with better knowledge about nutrition and food preparation. Regarding employment level, there were no statistically significant differences between household heads' employment in monogamous and 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. The consumption aggregates are computed from the expenditure sections of the questionnaire for general food and non-food expenditures and annualized from the post-harvest and post-planting seasons. Non-food expenditures comprise expenditures on items such as education, housing, clothing, among others. Total household expenditure is calculated by adding total food and non-food expenditures. 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<sup>3</sup>, 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.

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<sup>3</sup> 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

**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)
<i>Highest educational qualification among household members</i>								
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)
<i>Religion</i>								
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)
<i>Household Composition</i>								
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)
<i>Wealth Quintiles</i>								
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)
<i>Geographical Zones</i>								
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)
Observations	3839		2974		865		3839	

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

ii. **Table 2- Household Level Food Security Indicators, by Family Structure: Nigerian General Household Survey, Baseline data, 2011**

Table 2 provides descriptive statistics of food security variables and indicators for both polygynous and monogamous households, using the baseline survey data. 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 sub-family unit, or for all members of the household.

That being said, on examination of the RCSI and its component coping strategies, it is observed that in both waves of the survey, polygynous households reported resorting to fewer coping strategies than monogamous households did. While both sets of households had overall scores less than four, indicating that they were generally food secure, the total is significantly lower for polygynous households (1.01 versus 2.43) on average. With respect to dietary diversity, there were no significant differences in FCS between polygynous and monogamous households in the baseline survey year. In the second wave of the data, however, a greater proportion of polygynous households were found to have high dietary diversity (FCS > 35), compared to monogamous households. It appears that not only did polygynous households appear to resort to fewer coping strategies in the second wave of the survey (*not shown*), but they also had a better dietary diversity, compared to monogamous households.

**Table 2: Household Level Food Security Indicators, by Polygyny: Nigerian General Household Survey, Baseline data, 2011**

	<i>Aggregate</i>		<i>Monogamy</i>		<i>Polygyny</i>		<i>T-tests</i>	
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>(Mono-Poly)</i>	
# Days in past week rely on less preferred foods	0.68	1.45	0.74	1.47	0.47	1.34	0.258***	-4.56
# Days in past week limit portion sizes at mealtimes	0.39	1.04	0.44	1.1	0.18	0.72	0.222***	-5.89
# Days in past week reduce the number of meals eaten in a day	0.36	1.05	0.42	1.14	0.11	0.52	0.251***	-6.83
# Days in past week Restrict consumption by adults in order for small children to eat	0.22	0.85	0.25	0.93	0.08	0.44	0.137***	-4.59
Reduced Coping Strategies Index (0 - 56)	2.14	5.1	2.43	5.5	1.01	2.9	1.198***	-6.63
FCS poor, less than 21	0.04	0.19	0.04	0.18	0.05	0.22	-0.0135	(-1.80)
FCS borderline, 21-35	0.16	0.37	0.17	0.38	0.14	0.35	0.019	(1.40)
FCS good, greater than 35	0.8	0.4	0.8	0.4	0.81	0.39	-0.00559	(-0.37)
Food Consumption Score	53.24	20.19	53.1	19.96	53.77	21.03	0.0244	(0.03)
Observations	3789		2931		858		3789	

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

**iii. Table 3- Child Nutrition Measures, by Wife Rank: 2011 and 2013**

These tables provide child-level nutrition statistics disaggregated by wife rank separately for the 2010/2011 and 2012/2013 data. This section compares child health outcomes between monogamous and polygynous mothers; and between children of senior- and junior-wives in polygynous households. The height for age z-scores (HAZ) and weight for height z-scores (WHZ) were generated using the World Health Organization (WHO) 2006 growth standards.

In Tables 3a, children of monogamous mothers had better HAZ outcomes than children of polygynous mothers. This is consistent with the idea that wives in monogamous households could wield higher levels of bargaining power than their polygynous counterparts, allowing them to divert a greater amount of resources to their children. Using education as a proxy for bargaining power, it may be observed that women in monogamous marriages are more educated than their counterparts in polygynous marriages. Additionally, given the larger household sizes and number of child dependents in polygynous households (see Table 2), children in these households may be more susceptible to resource dilution, where scarce household resources are spread more thinly among larger numbers of children, subsequently resulting in poorer health and nutrition outcomes.

Although there are no apparent differences in child health outcomes between senior and junior wives in the first wave of the data, significant differences were observed in the second wave, during which children of junior wives appeared to have better long-run child health outcomes (HAZ). On the one hand, better health outcomes for children of junior wives in the long term may be explained by the lower ages of junior wives (see Table 4), which may imply lower ages at childbirth and healthier children. On the other hand, children of senior wives appeared to have better child health outcomes than children of junior wives in the short run (WHZ). This may be explained by the higher proportion of senior wives, compared to junior wives, who were engaged in income-earning activities (see Table 4). Incomes earned from engagement in these economic activities may then be applied to children's care, leading to better health and nutrition outcomes.



**Table 3a:** Summary Statistics of Child-Level Anthropometric measures, by Wife Rank; Nigerian General Household Survey, 2010/2011

	Monogamous Vs. Polygamous Mothers		Senior Vs. Junior Wives		Aggregate
	Monogamous mother	Polygynous mother	Senior Wife	Junior Wife	
Height for Age (HAZ)	-1.301*** (N= 914)	-1.934*** (N=395)	-2.091 (N=199)	-1.837 (N=224)	-1.495 (N=1471)
	t= 5.29		t= 1.31		
Weight for Height (WHZ)	0.011 (N=1030)	-0.092 (N=466)	-0.130 (N=231)	0.009 (N=267)	-0.011 (N=1664)
	t= 1.02		t= 0.834		

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

**Table 3b:** Summary Statistics of Child-Level Anthropometric measures, by Wife Rank; Nigerian General Household Survey, 2012/2013

	Monogamous Vs. Polygamous Mothers		Senior Vs. Junior Wives		Aggregate
	Monogamous mother	Polygynous mother	Senior Wife	Junior Wife	
Height for Age (HAZ)	-0.767 (N= 925)	-0.896 (N=431)	-1.394*** (N=160)	-0.645*** (N=390)	-0.807 (N=1790)
	t= 1.279		t= 4.33		
Weight for Height (WHZ)	-0.223 (N=928)	-0.181 (N=439)	0.033*** (N=159)	-0.424*** (N=404)	-0.239 (N=1814)
	t= -0.519		t= -3.40		

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

**iv. Table 4- Mother and Father Characteristics, by Family Structure, 2010/11**

In order to better understand the mechanisms behind these differences in child health outcomes, characteristics of mothers and fathers in polygynous versus monogamous unions are examined, as well as mothers by their status as senior or junior wives in polygynous unions.

There are statistically significant, though very small, age differences in ages of mothers in monogamous and polygynous households; on average, mothers in monogamous households were a little above 6 months older than mothers in polygynous households. The primary difference is that mothers in monogamous unions were better educated on average. While only 15% of mothers in monogamous marriages reported having no formal training, as many as 32% of mothers in polygynous households had no formal schooling. Additionally, while a little over a quarter of mothers in monogamous marriages had secondary school qualifications, only 13% of mothers in polygynous households reported having this qualification. Everything else being equal, it may be expected that this higher level of education would contribute to better food security outcomes in monogamous households, given that more educated mothers may be more knowledgeable about nutrition and dietary needs. The level of education could also be a proxy for bargaining power, which could improve child outcomes. This is consistent with what is observed in Table 3; children of monogamous mothers were better off in terms of weight and height on average.

With respect to employment, a slightly higher proportion of mothers in monogamous households were employed, compared to wives in polygynous households (67% versus 62%). Higher employment levels would also (all other factors being equal) be indicative of greater income and food affordability. Within polygynous households, the only significant difference between mothers who were senior and junior wives is that senior wives were on average two years older than junior wives. All the same, we would expect that younger mothers might have better child birth, and subsequently health outcomes, which is consistent with the differences in child health on average (see Table 4).

Fathers in polygynous households tended to be older than fathers in monogamous households by almost 5 years. Similar to mothers, the key difference between fathers in monogamous and polygynous unions was in education; fathers in polygynous marriages tended to be less educated, with 23% of these men having no education, compared to 14% of fathers in monogamous marriages. Additionally, 28% of fathers in monogamous marriages had a secondary school education, compared to only 16% of fathers in polygynous marriages. With respect to employment, 93% of fathers in the sample reported being employed, with no significant difference between fathers in monogamous and polygynous unions.

**Table 4:** Summary Statistics of Parent Characteristics, by Family Structure; Nigerian General Household Survey, 2010/2011

<b>Part A: Mother Characteristics by Polygyny</b>								
	Total		Monogamous		Polygynous		Difference	T-tests
	Mean	SD	Mean	SD	Mean	SD	Mono-Poly	
Age	30.73	7.65	30.95	7.69	30.33	7.55	0.619**	(2.69)
No education	0.19	0.39	0.15	0.35	0.32	0.46	-0.168***	(-10.07)
Basic education	0.43	0.5	0.44	0.5	0.41	0.49	0.0244	(1.14)
Secondary education	0.23	0.42	0.27	0.44	0.13	0.33	0.144***	(7.99)
Post Sec education	0.14	0.35	0.14	0.35	0.14	0.35	-0.00111	(-0.07)
Employed	0.65	0.48	0.67	0.47	0.62	0.48	0.0468**	(3.24)
Observations	4826		3117		1709		4826	
<b>Part B: Mother Characteristics by Wife Rank</b>								
	Total		Junior Wives		Senior Wives		Difference	T-tests
	Mean	SD	Mean	SD	Mean	SD	Junior-Senior	
Age	30.44	7.49	29.41	7.52	31.71	7.27	-2.303***	(-6.30)
No education	0.31	0.46	0.31	0.46	0.3	0.46	0.0121	-0.34
Basic education	0.42	0.49	0.41	0.49	0.43	0.5	-0.0154	(-0.41)
Secondary education	0.13	0.34	0.15	0.36	0.1	0.3	0.0501	-1.95
Post Sec education	0.15	0.35	0.13	0.33	0.17	0.38	-0.0468	(-1.73)
Employed	0.62	0.49	0.64	0.48	0.6	0.49	0.0361	-1.5
Observations	1665		921		744		1665	
<b>Part C: Father Characteristics by Polygyny</b>								
	Total		Monogamous		Polygynous		Difference	T-tests
	Mean	SD	Mean	SD	Mean	SD	Mono-Poly	
Age	42.4	10.53	40.73	10.2	45.46	10.45	-4.736***	(-15.21)
No education	0.17	0.38	0.14	0.35	0.23	0.42	-0.0915***	(-6.54)
Basic education	0.37	0.48	0.37	0.48	0.38	0.49	-0.0072	(-0.40)
Secondary education	0.25	0.43	0.28	0.45	0.16	0.37	0.121***	-7.56
Post Sec education	0.21	0.41	0.2	0.4	0.22	0.42	-0.0221	(-1.46)
Employed	0.93	0.26	0.93	0.25	0.92	0.27	0.0141	-1.78
Observations	4789		3101		1688		4789	

t statistics in parentheses

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

## **IV. METHODOLOGY**

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.

### **a. 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 (Mundlak, 1978; Chamberlain, 1980). 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.

### **b. 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:

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

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  $X_{ht}$ , all of which vary across households 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, all as presented in Appendix 1. This model also includes a vector of within-household averages of all time-varying covariates,  $\bar{X}_h$ . To the extent that  $\bar{X}_h$  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  $\tau_h$ , is included, as well as  $\varepsilon_{ht}$ , as the idiosyncratic error term for each household and time period.

To test the first hypothesis, (1) is estimated. The coefficient of interest is  $\alpha$ , and the anticipated direction of effect is ambiguous.

To test the second hypothesis, the following is estimated:

$$FS_{ht} = \alpha P_{ht} + \beta_1 W_{ht} + \gamma_1 X_{ht} + \gamma_2 \bar{X}_h + \delta T_t + \tau_h + \varepsilon_{ht} \quad (2)$$

Relative to (1), per capita total consumption is added,  $W_{ht}$ , as an indicator of household wealth, and include its within-household mean in  $\bar{X}_h$ . It is expected that  $\beta_1$  be positive. The magnitude or direction of any changes in  $\alpha$  are also interpreted.

To test the third hypothesis, indicators of household structure are added to the model:

$$FS_{ht} = \alpha P_{ht} + \beta_1 W_{ht} + \beta_2 F_{ht} + \eta D_{ht} + \gamma_1 X_{ht} + \gamma_2 \bar{X}_h + \delta T_t + \tau_h + \varepsilon_{ht} \quad (3)$$

Because of the interest in multiple facets of household composition, a dependency ratio indicator,  $D_{ht}$  is added, along with an indicator of the number of adult women in the household,  $F_{ht}$ . Within-household means of both of these variables to  $\bar{X}_h$  are also added. The direction of  $\beta_2$  is interpreted as an indicator of competition (negative) or cooperation (positive). The magnitude or direction of any changes in  $\alpha$  are also interpreted.

Finally, the fourth hypothesis is tested by estimating:

$$FS_{ht} = \alpha P_{ht} + \beta_1 W_{ht} + \beta_2 F_{ht} + \beta_3 A_{ht} + \eta D_{ht} + \gamma_1 X_{ht} + \gamma_2 \bar{X}_h + \delta T_t + \tau_h + \varepsilon_{ht} \quad (4)$$

Here, an indicator variable is included,  $A_{ht}$ , for whether the household has an agricultural livelihood and the within-household mean of  $A_{ht}$  in  $\bar{X}_h$ . The land size is employed as a proxy for agricultural livelihoods. The expected direction of  $\beta_3$  is ambiguous, and the magnitude or direction of any changes in  $\alpha$  will be interpreted.

### c. 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 health, 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. The hypotheses to be tested are outlined below:

1. The polygynous status of mother has a direct relationship with her child's health outcomes, controlling for all observables likely to otherwise determine child health or be highly associated with polygyny, including mother's characteristics, the child's birth order, and household-level characteristics. If children of polygynous mothers have worse health outcomes on average, when controlling for other factors, this indicates uncooperative equilibria in the distribution of household resources and the on average lower bargaining power of women in polygynous unions
2. While per capita expenditure should have a positive influence on child health, due to greater availability of resources for food and health, it is hypothesized that to the degree that mothers in polygynous unions have lower bargaining power, the positive influence of household expenditure will be less evident for the children of polygynous mothers
3. Other features of household structure, such as overall household size and number of caretakers, would also influence bargaining power and cooperation. Having more household members—in particular women—present increases the labor availability and hence resource base for child care. It is hypothesized, however, that a mother's status as polygynous specifically decreases her bargaining power, even in the presence of more caretakers or women. It is hypothesized that children of polygynous mothers may be better off from increased child care from the presence of more adult women in the household. A larger household size and dependency ratio may however lead to adverse outcomes as a result of resource dilution
4. Nutritional status of children of polygynous women may be better off if there is a high involvement in agricultural activity and output by mothers in these households. This is likely to increase access to food and nutrition for children in these households.

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:

$$Y_{iht} = \alpha_1 P_{iht}^m + \gamma_1 M_{iht} + \gamma_2 F_{iht} + \gamma_3 C_{iht} + \gamma_4 X_{ht} + \delta T_t + \mu_h + \varepsilon_{iht} \quad (1)$$

In this formulation,  $Y_{iht}$  is the health status (HAZ or WHZ) of child  $i$ , in household  $h$ , at time  $t$ .  $P_{iht}^m$  is a binary variable indicating whether the child's mother is in a polygynous union.  $M_{iht}$  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. A stepwise regression technique is used to examine the importance of mediators such as per capita wealth and household composition in subsequent specifications.

The first hypothesis is tested by observing the sign and significance of  $\alpha_1$ , the nature of the robust correlation between polygynous mothers with child health, controlling for these other drivers.

The second hypothesis, 2, is tested by including per capita wealth (consumption expenditure) in the regression:

$$Y_{iht} = \alpha_1 P_{iht}^m + \beta_1 W_{ht} + \gamma_1 M_{iht} + \gamma_2 F_{iht} + \gamma_3 C_{iht} + \gamma_4 X_{ht} + \delta T_t + \mu_h + \varepsilon_{iht} \quad (2)$$

The significance of  $\beta_1$  as well as changes to  $\alpha_1$  are observed and interpreted.

The third hypothesis is tested, delving further into the question of scale economies and household size, by including also the number of adult women, which may include, for example, other female relatives and children of daughters-in-law, rather than co-wives.:

$$Y_{iht} = \alpha_1 P_{iht}^m + \beta_1 W_{ht} + \delta_1 N_{ht} + \gamma_1 M_{iht} + \gamma_2 F_{iht} + \gamma_3 C_{iht} + \gamma_4 X_{ht} + \delta T_t + \mu_h + \varepsilon_{iht} \quad (3)$$

Here,  $N_{ht}$  is the number of adult women in the household. The sign and significance of  $\delta_1$  as well as changes to  $\alpha_1$  are observed and interpreted.

Finally, the fourth hypothesis is tested by included information on agricultural livelihoods:

$$Y_{iht} = \alpha_1 P_{iht}^m + \beta_1 W_{ht} + \delta_1 N_{ht} + \pi_1 A_{ht} + \gamma_1 M_{iht} + \gamma_2 F_{iht} + \gamma_3 C_{iht} + \gamma_4 X_{ht} + \delta T_t + \mu_h + \varepsilon_{iht} \quad (4)$$

Here,  $A_{ht}$  is an indicator variable for whether the household has an agricultural livelihood. The sign and significance of  $\pi_1$  as well as changes to  $\alpha_1$  are observed and interpreted.

## V. ESTIMATION RESULTS AND DISCUSSION

This section summarizes regressions results at the household and individual level. Data for three waves of the Nigerian General Household Survey are pooled; a correlated random effects model is used in

the household-level analysis, and a household-level fixed-effects model is used for the individual-level analyses.

### **a. Household-Level Regressions**

The results at the household level are presented in Table 6, 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. While the relationship between with RCSI is negative, as shown in Table 3, which also indicates on average better food security for polygynous households, this coefficient varies depending on the model and is not statistically significant.<sup>4</sup>

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.

While not the focus of attention for these hypotheses, other variables included in the regressions relate to food security more or less as expected. Polygynous households perform better than monogamous households with respect to food security, as measured by dietary diversity. Urban dwellers have better dietary diversity than their rural counterparts. Additionally, wealthier households have better dietary diversity and resort to fewer coping strategies, as do households that own more livestock. The presence of shocks is negatively correlated with households' use of coping strategies.

It is not surprising that there is some difficulty in identifying the mechanism behind the difference in food security between polygynous and monogamous households, for a couple of reasons. Mainly, as mentioned previously, a significant shortcoming in undertaking household-level analysis in this case lies in that it is uncertain who answered questions about dietary diversity and coping strategies. Additionally, it is difficult to determine the extent of that person's knowledge of the overall household's food consumption patterns and behaviors. As such it is difficult to draw conclusions about these results. The

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<sup>4</sup> The coefficient on polygyny in these regressions is negative and significant under some specifications, but loses this significance with the preferred model and specification, as shown.



findings from the present research appear to suggest better outcomes for polygynous households. This differs from existing literature, which often finds negative outcomes for women and children of polygynous households (Al-Krenawi & Graham, 2006; Arney, 2002; Kazinaga & Klonner, 2009). The findings are more consistent with Munro et al. (2010), who used experimental analyses in northern Nigeria to show that polygynous households were not necessarily less efficient than their monogamous counterparts, with respect to the allocation of household resources. Findings from the present research are also consistent with literature which considers polygyny to have a positive impact on the wives' consumption within polygynous households, in addition to increased labour sharing among co-wives with respect to domestic work, agricultural responsibilities or child care duties, which increases leisure time (Grossbard, 1980; Becker, 1981)

**Table 6:** Testing the Various Hypotheses- Regression Estimates of Polygyny in Nigeria (2010/11, 2012/13 and 2014/15 waves)

<i>Dependent Variables: Hypotheses:</i>	Food Consumption Scores				Reduced-Coping Strategies Index			
	H1	H2	H3	H4	H1	H2	H3	H4
Per Capita Expenditure		0.00 (0.30)	0.00 (0.09)	0.00 (1.09)		-0.00 (-0.63)	-0.00 (-0.44)	-0.00 (-0.84)
Dependency ratio			2.12 (1.00)	4.06* (1.74)			1.21* (1.93)	1.08 (1.53)
# Adult women			-0.39 (-0.93)	0.10 (0.22)			0.14 (1.21)	0.06 (0.47)
Household size			-0.03 (-0.11)	-0.41 (-1.20)			0.01 (0.16)	0.02 (0.19)
Land size (logged)				-0.19* (-1.67)				0.10** (2.37)
Polygyny	2.85*** (4.73)	3.23*** (5.28)	2.90*** (4.07)	2.94*** (3.86)	0.11 (0.73)	0.11 (0.73)	-0.07 (-0.39)	0.04 (0.22)
Male head	1.90 (0.89)	0.82 (0.36)	0.91 (0.40)	-0.51 (-0.22)	-1.21 (-1.17)	-1.25 (-1.15)	-1.24 (-1.14)	-1.04 (-0.71)
Age of Head	-0.06 (-1.34)	-0.06 (-1.30)	-0.06 (-1.35)	-0.09* (-1.65)	-0.01 (-0.97)	-0.01 (-0.46)	-0.01 (-0.71)	-0.01 (-0.46)
<i>Education (no education is base)</i>								
Basic	-0.64 (-0.68)	-0.90 (-0.95)	-0.82 (-0.87)	-1.12 (-1.14)	0.18 (0.66)	0.20 (0.76)	0.22 (0.81)	0.03 (0.11)
Secondary	0.13 (0.12)	-0.22 (-0.21)	0.01 (0.01)	-0.57 (-0.50)	0.30 (0.96)	0.40 (1.24)	0.43 (1.33)	0.33 (0.96)
Post-secondary	0.10 (0.08)	-0.38 (-0.32)	-0.09 (-0.07)	-0.18 (-0.14)	-0.18 (-0.55)	-0.10 (-0.30)	-0.07 (-0.20)	-0.18 (-0.54)
Muslim head	-45.01*** (-7.01)	-43.17*** (-5.88)	-42.96*** (-5.91)	-42.81*** (-5.72)	-1.12 (-0.55)	-1.28 (-0.63)	-1.33 (-0.63)	0.99 (0.43)
Urban	6.05 (1.51)	8.17* (1.86)	7.91* (1.80)	4.93 (0.69)	-1.48* (-1.65)	-1.26 (-1.30)	-1.29 (-1.36)	1.16* (1.86)
Wealth scores	0.70*** (2.97)	0.58** (2.38)	0.60** (2.45)	0.49* (1.73)	-0.35*** (-5.06)	-0.31*** (-4.36)	-0.31*** (-4.32)	-0.25*** (-2.94)
Tropical livestock Units	0.00 (0.36)	0.00 (0.35)	0.00 (0.34)	0.00 (0.31)	-0.00*** (-4.81)	-0.00*** (-4.23)	-0.00*** (-4.13)	-0.00*** (-3.75)
Shocks	0.48 (0.62)	0.55 (0.71)	0.52 (0.66)	0.92 (1.09)	0.81*** (3.41)	0.85*** (3.48)	0.85*** (3.48)	1.14*** (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 <sup>2</sup> - Within	0.02	0.02	0.02	0.03	0.12	0.12	0.12	0.13
R <sup>2</sup> - Between	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.27
R <sup>2</sup> - 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

## **b. Child -Level Regressions**

The results at the child level are presented in Table 7a and 7b below. In Table 7a, 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.

While not the focus of attention for these hypotheses, other variables included in the regressions relate to child nutrition more or less as expected. Children of older mothers have better nutritional outcomes in the long run, likely due to accumulated knowledge and experience over time. Children have better short-term (but worse long-term) nutritional outcomes when their mothers have had some education, compared to children of uneducated mothers. Studies have shown a decreased incidence of child malnutrition with increases in women's education since more educated parents may have more information on healthy nutritional choices for children, in addition to information on how to manage disease and sanitation most effectively (Strauss, 1990; Ganebo et al. 1999; Yimer, 2000; Marini and Gragnolati, 2003; Van de Poel et al., 2007). Children appear to experience worse long-term nutritional status with increasing age. This is consistent with other literature that finds that child malnutrition generally increases with child's age (Field et al., 1981; Blau, 1986; Ganebo et al. 1999; Alderman, 1999; Yimer, 2000; Van de Poel et al., 2007)

**Table 7a:** Household Fixed Effects Regressions of Child Health Outcomes on Polygyny- Nigerian General Household Survey (2010/11, 2012/13 and 2014/15)

	(H1)	(H2)	(H3)	(H4)	(H1)	(H2)	(H3)	(H4)
	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)
<i>Education (no education is base)</i>								
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)
<i>Education (no education is base)</i>								
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 (0.92)	0.25 (0.74)			-0.19 (-0.67)	-0.23 (-0.79)
Land size (logged)				-0.03 (-0.52)				-0.02 (-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 <sup>2</sup>	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

In Table 7b, 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 (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 (a reason for this result may however be that Strauss (1990) includes the children of monogamous wives with the children of senior wives, with children of junior wives as the comparison group).

A reason for this finding of better nutritional outcomes among junior wives may be that junior wives are younger than senior wives (see Table 3b). As noted above, younger mothers might have better child birth, and subsequently health outcomes. Additionally, this may hint that junior wives may not be as weak, with respect to their bargaining position, as may be expected (Strassman, 1997). 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.

Other regression results are present. An additional year of age increases children’s long-term nutritional outcomes. Additionally, mothers with post-secondary education have healthier children in the long run, compared to mothers with no education, even when household wealth is controlled for (Marini and Gragnolati, 2003; Van de Poel et al., 2007). Fathers’ education appears to be more relevant for child health outcomes in the short term, however. Ownership of livestock is positively correlated with child nutritional outcomes in the long- and short-term. This is because livestock may serve as direct sources of protein through meat, milk, and eggs or indirectly by increasing household income for food expenditure when livestock are sold. (Hetherington et al., 2017; Mosites et al., 2015). Interestingly, greater access to household assets is correlated with negative child health outcomes in the long- and short-term.

**Table 7b:** Household Fixed Effects Regressions of Child Health Outcomes on Wife Seniority- Nigerian General Household Survey (2010/1, 2012/13 and 2015/16)

	(H1)	(H2)	(H3)	(H4)	(H1)	(H2)	(H3)	(H4)
	Height-for-Age				Weight-for-Height			
Mother is Senior wife	-0.72** (-2.03)	-0.76** (-2.12)	-0.78** (-2.17)	-0.86** (-2.15)	0.07 (0.29)	0.05 (0.19)	0.05 (0.21)	0.12 (0.42)
Mother's age	0.06* (1.96)	0.06** (2.00)	0.06** (2.04)	0.07** (2.09)	-0.00 (-0.03)	-0.00 (-0.02)	-0.00 (-0.15)	-0.03 (-0.97)
<i>Education (no education is base)</i>								
Basic	0.06 (0.12)	0.06 (0.12)	0.01 (0.02)	0.12 (0.20)	0.29 (0.82)	0.32 (0.89)	0.30 (0.84)	0.45 (1.08)
Secondary	0.50 (0.74)	0.53 (0.78)	0.52 (0.75)	1.35 (1.57)	0.13 (0.28)	0.14 (0.29)	0.07 (0.13)	-0.29 (-0.49)
Post-secondary	2.00** (2.37)	1.98** (2.33)	1.97** (2.26)	2.36** (2.31)	-0.58 (-0.97)	-0.56 (-0.94)	-0.68 (-1.12)	-0.67 (-0.96)
Mother is employed	0.14 (0.32)	0.22 (0.48)	0.29 (0.63)	0.10 (0.20)	0.07 (0.21)	0.04 (0.13)	0.01 (0.03)	0.11 (0.32)
Fathers age	0.01 (0.23)	0.01 (0.20)	0.03 (0.58)	0.04 (0.65)	0.00 (0.06)	0.00 (0.05)	-0.01 (-0.32)	-0.02 (-0.51)
<i>Education (no education is base)</i>								
Basic	0.32 (0.50)	0.42 (0.64)	0.20 (0.29)	-0.22 (-0.29)	-0.29 (-0.66)	-0.34 (-0.74)	-0.14 (-0.31)	-0.22 (-0.43)
Secondary	-0.63 (-0.59)	-0.65 (-0.60)	-0.59 (-0.54)	-1.19 (-1.00)	2.15*** (2.80)	2.15*** (2.79)	2.17*** (2.81)	2.68*** (3.23)
Post-secondary	-0.31 (-0.24)	-0.50 (-0.39)	-0.85 (-0.64)	-0.66 (-0.42)	-0.03 (-0.04)	0.05 (0.05)	0.01 (0.01)	-0.40 (-0.37)
Father is employed	1.98* (1.65)	1.94 (1.61)	1.82 (1.34)	2.34 (1.59)	0.76 (1.10)	0.73 (1.05)	0.32 (0.40)	0.38 (0.46)
Muslim head	0.40 (0.15)	1.24 (0.44)	-0.58 (-0.16)	-0.17 (-0.04)	-0.72 (-0.37)	-1.06 (-0.52)	0.79 (0.31)	1.06 (0.39)
Child age (months)	0.04 (0.29)	0.03 (0.23)	0.01 (0.08)	-0.08 (-0.48)	0.01 (0.08)	0.01 (0.08)	0.03 (0.33)	-0.02 (-0.18)
Child birth order	-0.13 (-0.64)	-0.13 (-0.66)	-0.18 (-0.88)	-0.23 (-0.98)	-0.10 (-0.70)	-0.10 (-0.69)	-0.04 (-0.24)	-0.10 (-0.64)
Urban	-0.53 (-0.21)	-2.05 (-0.70)	-2.24 (-0.76)	-1.62 (-0.52)	0.44 (0.28)	1.02 (0.54)	1.42 (0.75)	1.01 (0.51)
Shocks	0.82 (1.45)	0.70 (1.19)	0.69 (1.15)	0.95 (1.43)	0.26 (0.64)	0.30 (0.73)	0.42 (0.99)	0.22 (0.49)
Tropical Livestock	0.22* (1.95)	0.20* (1.72)	0.24** (2.00)	0.28** (2.07)	0.22** (2.18)	0.23** (2.24)	0.22** (2.13)	0.18 (1.56)
Wealth scores	-0.36** (-2.12)	-0.33* (-1.93)	-0.36** (-2.03)	-0.36* (-1.87)	-0.23* (-1.87)	-0.25* (-1.93)	-0.26** (-2.00)	-0.13 (-0.93)
Per capita expenditure		-1.35 (-0.99)	-1.15 (-0.83)	-0.81 (-0.55)		0.54 (0.58)	0.29 (0.31)	0.16 (0.16)
Dependency ratio			2.54 (0.73)	1.26 (0.34)			-2.97 (-1.22)	-3.80 (-1.49)

Household size			0.11 (0.40)	0.16 (0.46)			-0.25 (-1.27)	-0.10 (-0.40)
# of Adult women			0.49 (0.89)	0.47 (0.78)			-0.00 (-0.01)	0.07 (0.17)
Land size (logged)				-0.01 (-0.05)				0.02 (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 <sup>2</sup>	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

## VII. CONCLUSION AND POLICY IMPLICATIONS

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 in 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.

First, the relationship between polygyny and household-level food security was examined, and the degree to which this is mediated by household wealth, size, and livelihood. Some evidence was found in support of the posited pathways. However, 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 mechanisms were also examined in order to determine whether mother's status as monogamous versus polygynous relates systematically to her child's health. Consistent with preliminary evidence, superior child outcomes were found in monogamous households, compared to polygamous households. Finally, within polygynous households, wellbeing of children of junior versus senior wives was compared, likewise examining how household and mothers' characteristics mediate outcomes. It was found that children of junior wives had better long term nutritional outcomes, compared to children of senior wives.

Despite the decrease in its prevalence over the past century, polygyny remains a prominent feature in many African countries (Fenske, 2011), including Nigeria. While there is no universal consensus, there is a general negative perception of the practice of polygyny primarily among women's rights advocates, given the noted adverse effects of this practice on women, and often times, children as well. On a more global scale, apprehension regarding the practice of polygyny is further highlighted by the UN's Committee on the Elimination of Violence Against Women, which states that polygyny violates the rights of women and should be banned. As mentioned in the present article however, some individuals do appear to have motivations for entering into polygyny such as men who enjoy greater social prestige from a larger number of wives and children, and in some cases, women who benefit from the social network and labour sharing from the presence of co-wives in polygynous settings.

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, Omer & Simhon, 2008). Indeed, polygyny is banned in a number of developed and developing 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, raising some concerns about potential negative effects of polygyny on child welfare outcomes in Nigeria.



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**Appendix 1: Description and Construction of Explanatory Variables for Household level regressions**

<b>Variable</b>	<b>Survey Question(s)</b>	<b>Variable Construction</b>
Polygyny	<ul style="list-style-type: none"> <li>None</li> </ul>	Dummy variable for presence of multiple wives in the household, from roster
Age of Household Head	<ul style="list-style-type: none"> <li>How old is [Name] in completed years?</li> <li>What is [Name]'s relationship to the head of the household?</li> </ul>	Age (in years) for household heads is constructed
Sex of Household Head (Male)	<ul style="list-style-type: none"> <li>What is [Name]'s relationship to the head of the household?</li> <li>What is the sex of [Name]</li> </ul>	Dummy Variable constructed for males who are household heads. Comparative group is females who are heads
Age of Wife	<ul style="list-style-type: none"> <li>How old is [Name] in completed years?</li> <li>What is [Name]'s relationship to the head of the household?</li> </ul>	Age (in years) for wife is constructed
Highest Educational qualification of household members	<ul style="list-style-type: none"> <li>What is your highest educational qualification? (information from Post-Planting season)</li> </ul>	<p>Given educational qualifications, an individual is classified as having <i>no education</i>; <i>basic education</i> (first school leaving certificate, modern school leaving certificate, vocational or commercial); <i>secondary education</i> (senior secondary school, A Level); <i>post-secondary</i> (National certificate of education or ordinary national diploma, Nursing, Bachelor's degree, Masters or higher)</p> <p>At the household level, this is constructed as a dummy variable for the head of the household.</p> <p>At the individual level, this is constructed as dummy variables for education status of child's parents</p>
Education of Wife	<ul style="list-style-type: none"> <li>What is your highest educational qualification? (information from Post-Planting season)</li> </ul>	Given educational qualifications, an individual is classified as having <i>no education</i> ; <i>basic education</i> (first school leaving certificate, modern school leaving certificate, vocational or commercial);

	<ul style="list-style-type: none"> <li>• What is [Name]'s relationship to the head of the household?</li> </ul>	<i>secondary education</i> (senior secondary school, A Level); <i>post-secondary</i> (National certificate of education or ordinary national diploma, Nursing, Bachelors degree, Masters or higher)
Dependency ratio	<ul style="list-style-type: none"> <li>• None</li> </ul>	This is constructed as a ratio of dependents (individuals below 15- and above 65-years of age) to all household members
Female share of household	<ul style="list-style-type: none"> <li>• None</li> </ul>	This is constructed as a ratio of females to total household members in the household
Number of adult women in household	<ul style="list-style-type: none"> <li>• None</li> </ul>	This is constructed from information on age (>15 years; >15 & <65) and gender (i.e. female)
Household size	(No survey question)	Count of number of individuals in the household roster
Urban locality	Sector (Urban/ Rural)	Dummy variable constructed for urban locality
Wealth scores	None	Principal component analysis (PCA) is used to create these wealth scores, using durable assets, and housing characteristics
Employment status of household head	<ul style="list-style-type: none"> <li>• During the past 7 days, have you worked for someone who is not a member of your household?</li> <li>• During the past 7 days, have you worked on a farm owned or rented by a member of your household...or have you cultivated livestock belonging to yourself or family member?</li> <li>• During the past 7 days, have you worked on your for yourself or in a business enterprise belonging to you or someone in your household?</li> </ul>	Dummy variable for employed is constructed if there is an affirmative response to any of these questions. Comparative group is individuals who responded 'no' to all three questions At the household level, construction restricted to household head At the individual level, this is constructed as a dummy variable for whether a child's parents work or not
Household Annual Expenditures (i.e. food and total) in USD	None	Food expenditure includes purchased foods, values of food received as gifts, values of food consumed from own production and daily expenditures on meals away from home

		<p>Total expenditure includes consumption and non-consumption expenditure</p> <p>Per capita values imply expenditures divided by household size</p>
Livestock ownership	How many [Animals] are owned by your household now?	Tropical Livestock Units (TLU) are calculated. Conversion scales are: cattle = 0.7, sheep = 0.1, goats = 0.1, pigs = 0.2, chicken = 0.01.
Religious denomination of household heads	What religion are you?	Dummy variables for Christianity, Muslim and Traditionalists.
Shocks	Has the household been affected by this shock in the past 5 years?	Dummy variable constructed from presence of idiosyncratic shocks
Land size (logged)	No question	Land measurement in square metres (GPS)
Zones	Zone	Dummy variables for north central, north east, north west, south east, south west and south west