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Women's Empowerment and Child Nutrition in Polygynous Households of Northern Ghana

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ABSTRACT

Weather shocks and other shocks affecting the economy of farm households often trigger a cascade of coping mechanisms, from reducing food consumption to selling assets, with potentially lasting consequences on child development. In polygynous households (in which a man is married to several women), the factors that may aggravate or mitigate the impacts of such adverse events are still poorly understood. In particular, little is known about the complex mechanisms through which women's empowerment may affect the allocation of household resources in the presence of more than one female decision-maker. Where polygyny is associated with discriminatory social norms, co-wives may have limited bargaining power, which may translate into poorer outcomes for their children. While competition between co-wives may generate inefficiencies in the allocation of household resources, cooperation in the domains of agricultural production or domestic labor may lead to economies of scale and facilitate informal risk sharing. The rank of each co-wife may also have a strong influence on the welfare of her own children, relative to other children. Using the Feed the Future Ghana Population Survey data, I investigate the relationship between polygyny and children's nutrition, and how it may be mediated through women's bargaining power. Using the age of each co-wife as a proxy for rank, I also study how the senior-wife status of a mother may influence her children's nutrition outcomes. The results suggest that polygyny is associated with low weight-for-height z-scores in children under the age of five but reveal no such relationship with height-for-age or weight-for age z-scores. I also find evidence that women's empowerment in agriculture may affect child nutritional status and diet quality differentially in polygynous households and monogamous households with different dimensions of empowerment having different impacts on child nutrition outcomes. Finally, within polygynous households, the effect of a mother's rank on exclusive breastfeeding practices and nutritional status of her own children is ambiguous, while there is no significant correlation between a mother's rank and the feeding practices of her children between 6 and 23 months old.

Keywords: Gender, nutrition, women's empowerment, polygamy

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ACRONYMS

5DE	Five Dimensions of Empowerment (Index)
BMI	Body Mass Index
DDS	Dietary Diversity Score
DHS	Demographic and Health Survey
GNI	Gross National Income
GPI	Gender Parity Index
HH	Household
IYCF	Infant and Young Child Feeding
MAD	Minimum Acceptable Diet
MDD	Minimum Diet Diversity
OLS	Ordinary Least Squares
PBS	Population-Based Survey
SE	Standard Error
USD	United States Dollars
WEAI	Women's Empowerment in Agriculture Index
WHO	World Health Organization

1. INTRODUCTION

Social protection programs, ranging from cash transfers to savings groups, are designed to reduce poverty and vulnerability by building their beneficiaries' capacity to anticipate and absorb adverse shocks. Among rural households that rely on agricultural production as their primary source of livelihood, weather shocks, in particular, can trigger a cascade of coping mechanisms, from reducing food consumption to selling assets, with potential long-term consequences for all household members. Expecting mothers and children under the age of five are especially affected by episodes of under- and malnutrition, which can have a lasting impact on a child's growth and development from the earliest days of life in-utero (Hoddinott and Kinsey, 2001; Maccini and Yang, 2009).

Such programs are increasingly targeted to women to support gender equity and women's empowerment, and because female recipients are thought to be more likely to contribute to the formation of human capital by reallocating financial resources towards children's health and education (Quisumbing and Malucchio 2003). A common assumption underlying the design of many of these programs is that improving potential determinants of women's bargaining power, such as health, education and access to employment opportunities, can strengthen and expand the influence of women on decisions related to the allocation of resources that are crucial to household and child welfare.

However, in households composed of multiple interacting family sub-units, predicting and alleviating the impact of shocks on each individual is not straightforward. In particular, little is known about the complex mechanisms through which women's empowerment may affect the allocation of household resources in the presence of more than one female decision-maker and what role bargaining power may play in the process. Polygyny (i.e. the marriage of a man to several women) is practiced in many countries of Africa South of the Sahara, and yet the factors that may aggravate or mitigate the impacts of adverse events on the members of polygynous households are still poorly understood.

Traditionally, research on the consumption and production activities of economic agents has regarded the household as the basic unit of decision-making (Samuelson, 1956; Becker, 1973): if household members share income and time, amenities and housing, display altruism and know each other's

preferences, their decisions and actions should be easily explained as those of a single representative agent. But a growing body of literature has since challenged the validity of the income pooling assumption by showing that who earns income or owns assets shapes how a household's resources are allocated among its members. For example, Hoddinott and Haddad (1995) demonstrate that an increase in the female share of household income results in an increase in the share of expenditures on food. Similarly, Duflo (2003) shows that transfers of income to women can have a positive impact on children's nutrition status and education. These findings suggest that household members interact strategically when choosing how to allocate resources among one another for consumption and production, given both individual and collective constraints. Under such non-unitary assumptions, positive or negative economic shocks may have a heterogeneous impact on the offspring of different mothers within the same household, which existing nuclear (i.e. two-parent) models of household resource allocation would fail to explain.

Where polygyny is associated with discriminatory social and cultural norms, co-wives (together and individually) may have limited bargaining power. If this translates into lower budget shares for certain types of expenditures (such as food or health care) or a skewed distribution of consumption goods between household members, women and children in polygynous households may present poorer health and nutrition outcomes, relative to their counterparts in monogamous households. The existing empirical evidence is mixed. While Wagner and Rieger (2011), using data from 28 African countries, find that children in polygynous households present poorer growth outcomes, other studies suggest that such correlations may disappear once ecological and socioeconomic confounding factors are accounted for (Lawson et al., 2015).

How polygyny shapes consumption and production decisions within the household may also depend on the nature of relationships between co-wives. Competition over limited resources, and in particular, over individual transfers from the husband, may generate inefficiencies in the allocation of resources. Where co-wife conflict is common, the relative rank of a co-wife may also have a strong influence on her children's welfare. In contrast, cooperation between co-wives in the domains of agricultural production, domestic labor or child rearing may lead to economies of scale, and perhaps, open

up opportunities for additional income-generating activities. In the face of shocks, informal risk-sharing mechanisms may also take place and buffer their negative impacts.

Several studies present evidence that, within polygynous families, children of senior (i.e. first) wives are better off compared to children of junior (i.e. any subsequent) wives. Using nationally representative data, Mammen (2004) finds that children of senior wives in Côte d'Ivoire receive more investment in their education while Kazianga and Klonner (2006) show that children of junior wives in Mali are associated with lower survival rates. Beyond husbands' favoritism, possible (and often, overlapping) factors that are thought to underlie such disparities in child outcomes and co-wives' control of family income include differences in bargaining power (Mammen, 2009; Kazianga and Klonner, 2006), productivity (Matz, 2016), and other traits of senior and junior wives such as family wealth and social status, some of which may be difficult to measure accurately (Gibson and Mace, 2007).

Experimental games recently conducted in Nigeria reveal that polygynous spouses and co-wives may cooperate less with one another than monogamous spouses in public goods games (Barr et al., 2016). While Akresh et al. (2016) find that polygynous households in rural Burkina Faso cooperate in agricultural production, evidence of how such cooperation may extend to child rearing or other domains of reproductive work is scarce.

In this paper, I explore the relationship between polygyny, bargaining power and child welfare, using Feed the Future Ghana Population-Based Survey data. Collected in 2012, these data contain detailed information on consumption and food security at the household-level, supplemented with anthropometric measurements and dietary assessments for every young child and every woman of reproductive age in the household.

I investigate the effect of polygyny on children's nutrition outcomes, and how it may be mediated through women's bargaining power. While the Women's Empowerment in Agriculture Index (WEAI), determined for the primary male and female adult decision makers, is only available for one of the co-wives (who is the most senior wife in a majority of – but not all – polygynous households), it provides a useful set of proxies for women's bargaining power in polygynous households relative to monogamous

households. Using the age of each co-wife as a proxy for rank, I also study how the senior-wife status of a mother may influence her children's nutritional status and diet quality outcomes.

I show that monogamous and polygynous households differ across a set of demographic and socio-economic variables, many of which have the potential to influence the effect of polygyny on child outcomes. Controlling for observable household, mother and child characteristics, I show that polygyny is associated with low weight-for-height z-scores in young children but I find no evidence of a significant correlation with either height-for-age or weight-for-age z-scores. I find consistent evidence that women's empowerment in agriculture affects child nutrition outcomes differentially in polygynous households and monogamous households. However, and most surprisingly, the sign of the correlation between empowerment and child nutrition in polygynous households depends on the specific domains of empowerment we choose to look at, whether it is women's involvement in production or credit decisions, or a measure of gender equality in the household. Finally, within polygynous households, the effect of a mother's rank on children's anthropometric z-scores is ambiguous, while I find no significant correlation between a mother's rank and the diet quality of her children between 6 and 23 months old. This may suggest that unobserved factors associated with rank (such as social status or family wealth) have a differential influence on the nutritional status of senior wives' and junior wives' children.

The rest of the paper follows the following structure. In Section 2, I briefly summarize the national and regional context of this study, using recent demographic statistics from national surveys representative of the current population of Ghana. In Section 3, I provide an overview of the data that are available for my analysis and explain how my sample was constructed. I describe my estimation strategy in Section 4 and present the main results in Section 5, along with the potential mechanisms at play. Finally, in Section 6, I discuss my findings and their relevance to policy and program design.

2. CONTEXT

For the past two decades, Ghana has sustained relatively high rates of economic growth, achieving the status of lower-middle income country in 2010.[1] National poverty levels fell by more than half during that period according to the nationally representative Ghana Living Standards Survey, last conducted in 2012-2013. However, inequality has been increasing in the country, as high poverty rates persist in the Northern, Upper East, and Upper West regions, and the gap between urban and rural areas widens (Cooke et al., 2016).

Estimates of basic demographic and health indicators at the national and regional levels, provided by the Ghana Demographic and Health Survey (DHS) reveal that while childhood mortality rates (and under-5 mortality, especially) have declined steadily in the past three decades, children in rural areas and children in the Northern region are more likely to die young. Two-thirds of children in Ghana, and four in ten women, are anemic. The nutritional status of Ghanaian children has also improved in the past fifteen years, placing Ghana among the countries in Africa South of the Sahara with the lowest national rates of stunting (an indicator of chronic malnutrition) in children under five. Yet, nearly 1 in 5 children under five in Ghana are still stunted and 1 in 3 children in the Northern region. Women's participation in the three domains of household decisions captured by the DHS survey questionnaire (own health care, major household purchases, and visits to family or relatives) also varies by region. In the Northern region, one-third of married women participate in all three decisions, less than in the Upper East and Upper West. Ownership and command of assets is skewed in favor of men: across the country, women are less likely to own a home or to own land, alone or jointly (Ghana Statistical Service, Ghana Health Service and ICF International, 2015).

According to the most recent DHS data, collected in 2014, the prevalence of polygyny in Ghana is in decline but still remains a common household structure, especially in rural areas where 20% of married women and 10% of married men of age 15 to 49 are in polygynous unions and in the Northern region where 42% of married women and 27% of married men are in polygynous unions.

[1] Lower-middle income economies are defined by the World Bank as those with a Gross National Income (GNI) per capita between $1,026 and $4,035 (World Bank, 2010).

3. DATA

Sample design

The Feed the Future Ghana Baseline Household Survey was administered in 2012 to a total of 4,410 households, statistically representative of the Feed the Future Zones of Influence (where Feed the Future Interventions activities are focused), which extend across 45 administrative districts of the Northern, Upper West and Upper East regions, as well as the Brong Ahafo region above the eighth parallel (Zereyesus et al., 2014). The survey sample was constructed following a two-stage methodology involving, first, the selection of enumeration areas and, second, a systematic sampling approach to select households in each sampled enumeration area.

The survey questionnaire was designed to estimate a set of key indicators that can be used to assess the baseline prevalence of poverty, hunger and the nutritional status of women and children. More specifically, in addition to household-level modules on household composition and consumption, every woman between 15 and 49 years of age was asked questions about her own consumption patterns and measured for height and weight. Anthropometric measurements were also taken for every child less than five years old. And for every child under two years of age residing in the household, his or her primary caretaker was asked questions about the child's consumption patterns (minimum adequate diet for children 6-23 months and exclusive breastfeeding for children 0-5 months). Finally, the survey instrument included the WEAI module, developed to capture women's empowerment along five dimensions that relate to agricultural activities (Alkire et al., 2013): production, resources, income, leadership and time. The WEAI module was administered to a primary male and primary female decision-maker[2], when applicable.

The household definition used in the survey (i.e. a group of persons who sleep and eat in the same housing unit) might result in the miscategorization of polygynous households. A polygynous family formed of a husband, his wives and their respective children could be captured in the dataset either in its entirety as a single household, if all of them live in the same house and share common cooking arrangements, or as

[2] The primary respondent is the person with the most decision-making authority in the household, i.e. typically a male adult in households with at least one male adult. The secondary respondent is the person of opposite sex to the primary respondent who has the most decision-making authority in the household in the absence of the primary respondent, i.e. a female adult if the primary respondent is a male adult and there is at least one female adult in the household.

multiple separate households. Because I am primarily interested in studying the interactions both between husband and wife, and among co-wives, and because the Feed the Future data do not link multiple households that are related through polygynous unions, I choose to focus my analysis on the polygynous households that co-reside. For the same reason, I also exclude from my estimation sample households with a male adult and no female adult (9.8% of interviewed households) and households with a female adult and no male adult (8.7% of interviewed households). Finally, I rely on self-reported household membership status (using the *relationship to the primary respondent* variable for each individual) and define as a polygynous household any household with either a male primary respondent and more than one *wife*, or a female primary respondent along with a *husband* and at least another *wife*, living together at the time of the interview. A related question in the household roster captures the marital status of each adult household member and reveals that the terms *husband* and *wife* are used to characterize not only legal or formal unions but also informal or consensual unions, all of which I include in my definition of a polygynous union. Similarly, the monogamous households I choose to retain as the comparison group are households with a male primary respondent and a single *wife*, or a female primary respondent and a single *husband* (and no other *wife*).

The resulting primary sample consists of 2,719 monogamous households and 617 polygynous households. For any analysis related to women's empowerment, I further restrict the sample to rural households (78% of the primary sample), to avoid misclassifying women in urban areas as disempowered if their household is not involved in agricultural production. Therefore, the number of observations may vary across specifications, depending on the occurrence of missing observations, as well as inclusion criteria specific to each estimation model.

Descriptive statistics

How do monogamous and polygynous households differ?

A comparison of key demographic and socio-economic indicators reveals that the two types of households differ significantly along multiple dimensions (Table 3.1).

Table 3.1 Comparison of household characteristics in monogamous and polygynous households

	Monogamous Households (N = 2,719)		Polygynous Households (N = 617)		Difference in means	
Variable	Mean	SE	Mean	SE	Diff.	t-test p-value
Household composition						
Number of household members	5.60	0.05	9.99	0.16	-4.39	0.00
Number of children under 5	0.83	0.02	1.60	0.05	-0.77	0.00
Adult female-to-male ratio	1.08	0.01	1.64	0.04	-0.56	0.00
(Total) Dependency ratio	1.09	0.02	1.33	0.04	-0.24	0.00
Child Dependency ratio	0.99	0.01	1.20	0.03	-0.22	0.00
Household head						
Age of the household head	43.39	0.30	50.18	0.63	-6.78	0.00
Household head can read and write	0.24	0.01	0.13	0.01	0.11	0.00
Household head has formal education	0.19	0.01	0.06	0.01	0.12	0.00
Rural locality	0.77	0.01	0.81	0.02	-0.04	0.03
Cultivated land allocated to three major crops (maize, rice, soybeans)						
Total acreage	3.79	0.12	6.86	0.29	-3.07	0.00
Per-capita acreage	0.78	0.03	0.73	0.03	0.05	0.37
Household expenditures						
Total real daily expenditures (USD)	16.51	0.34	21.87	0.77	-5.36	0.00
Per capita real daily expenditures (USD)	3.36	0.07	2.45	0.12	0.91	0.00
Less than 1.25 USD per person per day	0.23	0.01	0.38	0.02	-0.15	0.00
Per capita daily food expenditures (USD)	2.12	0.05	1.63	0.01	0.49	0.00
Household hunger score	1.06	0.02	1.03	0.05	0.02	0.69

Relative to monogamous households, polygynous households have more members (and more children under the age of five), have a larger share of adult female members as well as a larger share of dependents (younger or older household members, or both). The household head in polygynous households is less likely to be able to read and write and less likely to have received formal education. Polygynous households are typically further advanced in their "development cycle", as defined by Fortes (1958),[3] in part because husbands must often accumulate a certain amount of wealth before they can take on a new co-wife. This may account for some of the important differences observed between polygynous and monogamous households, such as in household size or age of the household head. While polygynous households have 4.6 more members on average, I find no significant difference in the household hunger scale, suggesting that there may be economies of scale in food consumption, also consistent with lower per-capita food expenditures observed among polygynous households. In my sample, polygyny is more prevalent in rural areas, among households of Islamic or Traditionalist faith and less prevalent among households of Catholic

[3] The concept of developmental cycle, formalized by Fortes (1958), reflects the dynamic nature of domestic groups such as households, expanding as marital unions are formed or children are born, and shrinking as adults reach old age.

or Protestant faith (Table 3.2). Out of the ethnic groups that are most represented in the northern regions of Ghana, polygyny is more prevalent among the Mole-Dagbani and the Gurma, and less prevalent among the Guan, the Akan and the Grussi.

Table 3.2 Prevalence of polygyny among the main religious and ethnic groups in the survey area

	N (Total size of each group)	Percentage of polygynous households in each group
Main religious groups		
Islam	1,548	21.90%
Traditionalist	687	24.60%
Catholic	454	9.03%
Protestant	126	3.97%
Pentecostal/Charismatic	301	10.30%
Other Christian	144	13.89%
Main ethnic groups		
Mole-Dagbani	1,695	20.24%
Gurma	809	21.26%
Guan	245	12.24%
Akan	170	7.06%
Grussi	160	13.12%

As the survey does not directly capture earned and unearned household income, I use as proxy for wealth the daily real total consumption in 2010 USD constant prices computed by Zereyesus et al. (2014) for the Ghana sample. I find that polygynous households have higher total expenditures, but significantly lower per-capita expenditures. In order to further explore associations between polygyny and wealth, I also compute the total acreage allocated to the three crops that constitute the focus crops for the Feed the Future initiative in Ghana: maize, rice and soybeans. Because these three majors crops together account for a substantial share of agricultural production in the northern regions of Ghana, in terms of land coverage, quantity produced and revenue (Amanor-Boadu et al., 2015), acreage under these crops may be a reasonable approximation of total cultivated land area for a majority of households. I find that, relative to monogamous households, the average total acreage allocated to maize, rice and soybeans by polygynous households is larger which seems consistent with the "wealth-increasing" theory of polygyny (White, 1988).[4] However, there is no statistically significant difference between mean per-capita land areas between polygynous and monogamous households.[5]

[4] The "wealth–increasing" or "resource-holding" theory is commonly cited as a justification for the persistence of polygyny: men of sufficient age or wealth seek to obtain extra wives as an economic asset in the form of labor. Women, on the other hand, marry into polygynous households as long as the cost of sharing a husband is offset by his higher wealth or quality (Gibson and Mace, 2007). Under this model, polygynous households are expected to be associated with larger wealth levels and landholdings.

[5] If total acreage of cultivated land is limited by labor availability (rather than land availability), the absence of evidence for

Although the relationships discussed so far should only be interpreted as correlations, there are important insights to be gained from these preliminary descriptive statistics. Notably, the relationship between wealth proxies and polygyny is somewhat ambiguous. Qualitative studies of polygynous households conducted in the northern regions of Ghana seem to confirm that a man must hold sufficient wealth in order to take on an additional wife (Nyamekye, 2016). However, increasing household size and a larger share of young children may gradually offset wealth at the time of marriage. A test of this hypothesis would require panel data or recall data on the family history (e.g. year of marriage). Indeed, the sign of the correlation between wealth and polygyny may depend critically on differences in household size and composition between monogamous and polygynous households. A review of previous research on poverty and household size by Lanjouw and Ravallion (1995) also highlights the conflicting signs that are found across existing studies and suggests that naïve per-capita measures of wealth that fail to reflect the diversity in household demographics likely underestimate possible economies of size in larger households.

Do co-wives in polygynous households have different individual characteristics?

Next, using age as a proxy for co-wife seniority, I compare individual characteristics of monogamous wives, senior wives (i.e. the first wife in a polygynous household) and junior wives (i.e. any wife younger than the senior wife in a polygynous household) .[6] As expected, senior wives are significantly older than monogamous wives, consistent with the notion that polygynous households are further advanced in their "developmental cycle." Although the numbers are not reported here for brevity, first (or senior) wives are on average 8.39 years older than second wives. However, I find no significant difference between the ages of junior wives of different ranks, and only include the pooled averages for junior wives in Table 3.3. Monogamous wives are more likely to be literate and more likely to have received formal education, relative to polygynous wives. There is no evidence of differences in educational attainment between senior and junior wives. Looking at monogamous and polygynous wives of reproductive age (15 to 49 years), I find that monogamous wives have a higher body mass index (BMI) compared to senior co-wives, although there

a monogamous advantage in per-capita acreage may reflect the fact there is more labor in polygynous households relative to monogamous households.

[6] The total number of co-wives in polygynous households ranges from two to five. Of all polygynous households in the sample, 83.5% have 2 co-wives, 13.7% have 3 co-wives, and 3% have 4 or 5 co-wives. In the analysis that follows, I choose to pool all junior wives together (rank two through five).

is no significant difference in the diversity of their individual diet. The results in Table 3.3 suggest that nutrition outcomes among women of reproductive age are fairly homogeneous within polygynous households. And because senior wives are significantly older that monogamous wives, the difference in BMI could be very well driven by a cohort effect (reflecting overall improvements in children's and women's health over time).

Table 3.3 Wife characteristics in monogamous and polygynous households

	Monogamous wife	Senior wife	Junior wives	Mono - Senior	Mono - Junior	Senior - Junior
All wives	N=2,719	N=617	N=739	Difference in means		
Age	35.83	43.18	34.65	-7.35***	1.18**	8.53**
	(0.24)	(0.54)	(0.45)	(0.57)	(0.52)	(0.70)
Can read and write	0.12	0.05	0.05	0.07***	0.07***	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Has formal education	0.09	0.02	0.02	0.07***	0.06***	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Wives of reproductive age	N=2,066	N=380	N=545	Difference in means		
Age	31.27	35.13	31.78	-3.86***	-0.51	3.35***
	(0.17)	(0.37)	(0.33)	(0.43)	(0.38)	(0.51)
Body mass index (BMI)	22.45	21.99	22.20	0.46*	0.24	-0.21
	(0.10)	(0.180	(0.20)	(0.23)	(0.22)	(0.28)
Dietary diversity score[7]	3.63	3.74	3.65	-0.11	-0.02	0.09
	(0.03)	(0.07)	(0.06)	(0.08)	(0.07)	0.09)

Standard errors in parentheses. * p<.1, ** p<.05, *** p<.01

Are women in polygynous households generally less empowered?

The Women's Empowerment in Agriculture Index (WEAI) was designed to directly capture women's empowerment and participation in economic activities related to agriculture (Alkire et al., 2013). I start by exploring potential correlations between polygyny and the ten binary indicators of empowerment, which form the five dimensions of empowerment index (5DE), in Table 3.4 Each indicator takes the value 1 if the respondent's status is adequate, that is, if the measure of empowerment is above a given threshold specific to the indicator. In households where the 5DE score is available for both a male and a female decision-maker, the gender parity index (GPI) is computed to assess women's empowerment relative to that of men within a household. Gender parity is achieved if the woman is empowered or her empowerment score is at least as high as that of the male in her household. The gender parity gap measures the distance between the scores of the male and female decision-makers in the household when gender parity is not achieved.

[7] The women's dietary diversity score is constructed as the number of food groups consumed (out of nine) on the day preceding the interview.

Table 3.4 Comparison of women's empowerment indicators (in rural areas only)

	Monogamous Households		Polygynous Households		Difference in means	
Variables	Mean	SE	Mean	SE	Diff.	t-test p-value
Indicators (=1 if adequate)	N=1,225		N=289			
Domain 1: Production						
Input in productive decisions	0.72	0.01	0.65	0.03	0.06	0.03
Autonomy in production	0.78	0.01	0.71	0.03	0.06	0.02
Domain 2: Resources						
Ownership of assets	0.54	0.01	0.52	0.03	0.02	0.58
Rights over assets	0.36	0.01	0.33	0.03	0.04	0.22
Access to and decisions on credit	0.34	0.01	0.29	0.03	0.05	0.10
Domain 3: Income						
Control over use of income	0.78	0.01	0.76	0.03	0.02	0.58
Domain 4: Leadership						
Group membership	0.72	0.01	0.71	0.03	0.01	0.80
Speaking in public	0.71	0.01	0.74	0.03	-0.03	0.39
Domain 5: Time						
Workload	0.60	0.01	0.56	0.03	0.04	0.20
Leisure	0.88	0.01	0.89	0.02	-0.02	0.45
5DE						
5DE index	0.26	0.01	0.17	0.02	0.09	0.00
5DE score	0.68	0.01	0.66	0.01	0.03	0.07
Gender parity	N=1,038		N=239			
Gender parity index	0.30	0.01	0.20	0.03	0.10	0.00
Gender parity gap	0.26	0.01	0.30	0.01	-0.04	0.02
Characteristics of the female WEAI respondent	N=1,225		N=289			
Age	36.38	0.36	39.93	0.77	-3.55	0.00
Can read and write	0.07	0.01	0.01	0.01	0.06	0.00
Has formal education	0.05	0.01	0.01	0.01	0.04	0.00
Time use	N=1,685		N=399			
Hours per day spent cooking	2.48	0.03	2.26	0.05	0.22	0.07
Hours per day spent on other domestic work	2.36	0.05	2.39	0.12	-0.04	0.11
Hours per day spent on care for children/elderly	1.45	0.06	1.37	0.11	0.08	0.13

Note: Prior to generating Table 3.4, I restrict the sample to rural areas (which accounts for about 78% of households in the original sample).

An important limitation of these measures for my proposed analysis is that they may not be representative of the empowerment of all adult women in a household, since the module is only administered to a primary and a secondary decision-maker (of opposite gender). In particular, by definition, I expect the female decision-maker captured by the survey to be more empowered than other women in the household (including her co-wives, if any). Nevertheless, I take the available female WEAI indicators as a reasonable upper bound for women's empowerment in the household. Interestingly, the female WEAI respondent, i.e. the female adult in the household with the most decision-making authority, only coincides with the senior wife in 69.9% of polygynous households that were administered the WEAI questionnaire (Table 3.5). While this could suggest that, in some polygynous households, a junior wife was identified by the survey team as the female adult with the most decision-making authority, it is also possible that

enumerators chose to interview the first wife they were able to find, especially if other co-wives were absent when the household was visited. On average, the female WEAI respondent is older and less likely to be literate or have formal education in polygynous households. The female WEAI respondent in polygynous households also spends less time cooking every day relative to her counterpart in monogamous households but there is no statistically significant difference in the time spent on other types of domestic work (such as fetching water) or in the time spent caring for other household members including children.

Table 3.5 Rank of the female WEAI respondent in polygynous HHs (in rural areas only)

	N	Percentage of respondents
First wife (i.e. oldest)	202	69.90%
Second wife	81	28.03%
Third or fourth wife	6	2.08%

Note: Prior to generating Table 3.5, I restrict the sample to rural areas (which accounts for about 78% of households in the original sample).

I find that female decision-makers on average are less likely to be empowered in polygynous households, where the average 5DE empowerment score is lower by 0.03 (Table 3.4).[8] In particular, limited input and autonomy in production decisions (such as input choice, crop choice, sales decisions, etc.) in polygynous households appear to be driving the results. These two sub-domains relate specifically to agricultural production, the main activity and source of income for a majority of rural households. The female decision-maker in polygynous households is also more likely to have no input in her household's decisions about credit sources (i.e. whether to borrow or what to use the loan for), compared to monogamous households[9]. Finally, comparing the empowerment scores of the primary male and female decision-makers, I find that the gender parity gap in polygynous households is significantly larger than in monogamous households.

As they investigate the linkages between women's empowerment in agriculture and women's and children's nutrition outcomes (using the same 2012 Ghana population-based Feed the Future survey data), Malapit and Quisumbing (2015) show that the production and resources domains have the highest

[8] To be consistent with the construction of the WEAI index and with the methodology adopted by Malapit and Quisumbing (2015), I use the censored 5DE empowerment score, which is equal to the weighted sum of the ten binary indicators if the individual is not empowered (i.e. if the weighted sum is strictly less than .80) and equal to 1 if the individual is empowered.

[9] The "access to and decisions on credit" indicator also takes the value 0 if the household does not have access to any credit source. However, I find no difference in the credit indicator between monogamous and polygynous households when looking at the *male* decision-maker's empowerment scores, which suggests that monogamous households are not more likely to have access to credit. Therefore, I cautiously interpret the female decision-maker's credit indicator as a measure of input into credit decisions, as much as access to credit sources.

contributions to women's disempowerment in northern Ghana. Since my findings suggest that those same domains drive the difference in women's empowerment between polygynous and monogamous households, I examine how the impact of polygyny on children's nutrition outcomes may be mediated by the degree of women's empowerment in the household, with a particular focus on measures of their participation in agricultural production decisions and credit decisions.

4. EMPIRICAL STRATEGY

Polygyny and child nutrition outcomes

The descriptive analysis conducted in the previous section clearly demonstrates that monogamous and polygynous households differ significantly along many characteristics (such as household demographics and wealth) that are both readily observable and likely to affect children's health and nutrition. First, to examine whether polygyny is associated with poorer child outcomes in my sample, I estimate the following model:

$$Y = \alpha_0 + \alpha_1 Poly + \alpha_2 H + \alpha_3 M + \alpha_4 C + \varepsilon \quad (1)$$

where $Poly$ is a binary variable that takes the value 1 if the child's household is polygynous; and Y represents the child's nutrition outcome of interest. I use several nutrition indicators (height-for-age z-score, weight-for-age z-score and weight-for-height z-score) and run a separate regression for each. Height-for-age is often used as a long-term proxy for child health because it is a cumulative measure that can be irreversibly affected by early-life shocks and poor environment. Height-for-age z-scores that are too far below the WHO Child Growth Standards median can indicate chronic malnutrition, from prolonged periods of insufficient or inadequate diet and frequent illness episodes. In contrast, weight-for-height and weight-for-age are more sensitive to contemporaneous nutritional deficiencies and morbidity.

I control for observed household's characteristics (H), mother's characteristics (M) and child's characteristics (C) that I believe may be correlated with both polygyny status and child's health and nutrition. Household control variables include household size, age and age squared of the household head, dependency ratio, quintiles of per capita expenditures, whether the household is located in a rural area, and region dummies. Mother control variables (when mother or caretaker information is available) include height, age and age squared, and literacy. Child control variables include age and age squared, and gender. If these controls account for all the factors that may influence the child-level outcomes of interest and polygyny is uncorrelated with the error term, ordinary least square (OLS) coefficients will be unbiased.

An important limitation of the proposed estimation strategy lies in the potential endogeneity of a household's marital structure, which would result in biased estimates. Indeed, I cannot rule out the possibility that unobserved characteristics at both the household's level and the mother's level may affect

a child's health and nutrition and be correlated with their propensity to form a polygynous household. In the absence of suitable instruments, I interpret the estimated OLS coefficients as conditional correlations rather than causal relationships.

Women's empowerment, nutrition outcomes and feeding practices

In order to analyze how polygyny and women's empowerment may interact and influence child nutrition, I estimate the following model:

$$Y = \beta_0 + \beta_1 Poly + \beta_2 WEAI + \beta_3 Poly * WEAI + \beta_4 H + \beta_5 M + \beta_6 + \epsilon \qquad (2)$$

where $WEAI$ is one of four different indicators of women's empowerment I describe in Section 5. A statistically significant coefficient on the interaction term would suggest that women's empowerment has a differential effect on child nutrition outcomes in monogamous and polygynous households. Furthermore, the sum of the coefficient on the empowerment indicator and the interaction term may provide an estimation of the direction and magnitude of the impact of women's empowerment in polygynous households.

As discussed in the introduction, a plausible pathway through which women's empowerment may influence a child's nutrition status relates to the quality and diversity of the child's diet. Empowered women may exercise more control over the household's resources and, thus, may be better able to adopt feeding practices that are beneficial to infants and young children. Focusing on children under 24 months (for whom data on feeding practices is available), I re-estimate the model specified in Equation (2), with four different outcomes of interest commonly used to assess infant and young child practices: whether the infant 0-6 months is exclusively breastfed; the dietary diversity score (DDS) or the number of food groups out of seven the child 6-23 months consumed in the past day; the minimum diet diversity (MDD) or whether the child 6-23 months consumed a minimum number of food groups in the past day; and the minimum acceptable diet (MAD) or whether the child 6-23 months has achieved both minimum diet diversity and minimum meal frequency.

Mother's rank, nutrition outcomes and feeding practices

In polygynous households, hierarchy between co-wives and differences in bargaining power may lead to intra-household inequalities in diet quality, and therefore, nutritional status among children. For the

remainder of my analysis, I restrict the sample to polygynous households (in rural areas) only and their children under 24 months. To investigate the potential effect of a co-wife's rank on the nutrition outcomes of her children, I use the age order of co-wives as a proxy for rank and define as senior co-wife the oldest co-wife in the household. I estimate the following regression model using OLS:

$$Y = \gamma_0 + \gamma_1 Senior + \gamma_4 H + \gamma_5 M + \gamma_6 C + \mu \quad (3)$$

where $Senior$ is a binary variable that takes the value 1 if the child's mother is the senior wife; Y represents child-specific indicators of diet quality and nutritional status; and all other variables have the same interpretation as in previous specifications.

5. RESULTS

Polygyny and child nutrition outcomes

While the Feed the Future Baseline survey collects anthropometric measurements on all children under the age of five, the link between mother and child can only be established for children under two. Therefore, I start by estimating the regression model in Equation (1) on the sample of all children under 5 without controlling for mother characteristics. Table 5.1 presents the results of the OLS estimation. I find that polygyny is negatively correlated with weight-for-height z-score, which may be indicative of weight loss due to recent illness or food shortage. The relationship is robust to the inclusion of child and household control variables. In contrast, there is no evidence that polygyny has a significant effect on height-for-age z-score and weight-for-age z-score, controlling for child and household characteristics.

Table 5.1 Effect of polygyny on nutritional status of children 0 to 59 months

	Height-for-age		Weight-for-height		Weight-for-age	
	(1)	(2)	(3)	(4)	(5)	(6)
Polygynous HH	-0.0093	0.040	-0.22***	-0.26***	0.011	-0.021
	(0.088)	(0.10)	(0.071)	(0.087)	(0.068)	(0.081)
Child controls	No	Yes	No	Yes	No	Yes
Mother controls	No	No	No	No	No	No
Household controls	No	Yes	No	Yes	No	Yes
Region dummies	No	Yes	No	Yes	No	Yes
Observations	2,877	2,876	2,755	2,754	2,958	2,957
Adjusted R^2	0.000	0.090	0.003	0.025	0.000	0.024

Note: Robust standard errors in parentheses. Full regression results are available in Table A.1 of the Appendix.
*** p<0.01, ** p<0.05, * p<0.1

Women's empowerment, nutrition outcomes and feeding practices

Before I estimate the regression model in Equation (2), I restrict the sample to rural households, to ensure that female WEAI indicators among urban households that are not engaged in agricultural production are not misinterpreted as low empowerment. For comparison, I also include the estimates from the regression model in Equation (1) for the same sample. Following Malapit and Quisumbing (2015), I consider four different proxies for women's empowerment: the 5DE empowerment score, the gender parity gap, the total number of decisions related to agricultural production in which the female WEAI respondent has some input and the average number of decisions related to credit in which the female WEAI respondent has some input.

Table 5.2 Effect of polygyny and women's empowerment on nutritional status of children 0 to 59 months

	Height-for-age		Weight-for-height		Weight-for-age	
	(1)	(2)	(3)	(4)	(5)	(6)
Model 1: 5DE empowerment score						
Polygynous HH	-0.028	-0.88**	-0.34***	0.34	-0.067	0.40
	(0.15)	(0.42)	(0.12)	(0.37)	(0.11)	(0.36)
Female 5DE score		-0.25		0.15		-0.19
		(0.30)		(0.25)		(0.22)
Poly * 5DE score		1.27**		-1.02**		-0.69
		(0.61)		(0.51)		(0.50)
Effect of empowerment on children of polygynous HH:						
(5DE)+(Poly*5DE)		1.02*		-0.87*		-0.88*
F-test (p-value):						
(5DE)+(Poly*5DE)=0		0.056		0.050		0.051
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Mother controls	No	No	No	No	No	No
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,366	1,366	1,311	1,311	1,406	1,406
Adjusted R^2	0.077	0.079	0.017	0.019	0.012	0.015
Model 2: Gender parity gap						
Polygynous HH	-0.082	0.0017	-0.43***	-0.65***	-0.78	-0.47**
	(0.16)	(0.27)	(0.14)	(0.21)	(0.12)	(0.19)
Gender parity gap		-0.37		-0.35		-0.28
		(0.32)		(0.27)		(0.24)
Poly * Gap		-0.30		0.75		1.35**
		(0.69)		(0.63)		(0.59)
Effect of empowerment on children of polygynous HH:						
(Gap)+(Poly*Gap)		-0.67		0.39		1.06**
F-test (p-value):						
(Gap)+(Poly*Gap)=0		0.27		0.49		0.049
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Mother controls	No	No	No	No	No	No
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,145	1,145	1,103	1,103	1,172	1,172
Adjusted R^2	0.062	0.062	0.028	0.028	0.019	0.023
Model 3: Total number of decisions related to agricultural production						
Polygynous HH	0.011	-0.23	-0.34***	-0.49***	-0.081	-0.17
	(0.12)	(0.16)-	(0.099)	(0.15)	(0.091)	(0.14)
# of production decisions		-0.027		-0.0017		-0.017
		(0.020)		(0.018)		(0.014)
Poly * Decisions		0.078**		0.048		0.029
		(0.037)		(0.032)		(0.029)
Effect of empowerment on children of polygynous HH:						
(Decisions)+(Poly*Decisions)		0.052*		0.046*		0.012
F-test (p-value):						
(Decisions)+(Poly*Decisions)=0		0.093		0.079		0.65
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Mother controls	No	No	No	No	No	No
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,022	2,022	1,949	1,949	2,086	2,086
Adjusted R^2	0.091	0.091	0.026	0.026	0.024	0.024

	Height-for-age		Weight-for-height		Weight-for-age	
	(1)	(2)	(3)	(4)	(5)	(6)
Model 4: Average number of decisions related to credit						
Polygynous HH	0.042	-0.11	-0.35***	-0.29***	-0.11	-0.13
	(0.12)	(0.13)	(0.10)	(0.11)	(0.091)	(0.099)
# of credit decisions		-0.076		0.078		-0.021
		(0.065)		(0.060)		(0.051)
Poly * Decisions		0.41***		-0.17		0.047
		(0.13)		(0.11)		(0.10)
Effect of empowerment on children of polygynous HH:						
(Decisions)+(Poly*Decisions)		0.336***		-0.087		0.026
F-test (p-value):						
(Decisions)+(Poly*Decisions)=0		0.003		0.350		0.766
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Mother controls	No	No	No	No	No	No
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,983	1,983	1,919	1,919	2,050	2,050
Adjusted R^2	0.091	0.096	0.026	0.026	0.024	0.024

Note: Robust standard errors in parentheses. Full regression results are available in Tables A.2-A.4 of the Appendix.
*** p<0.01, ** p<0.05, * p<0.1

The coefficient estimate on women's empowerment is insignificant in all three anthropometric z-score equations, and for any of the four measures of empowerment (Table 5.2). In model 1, using the women's empowerment score (5DE), the interaction term between polygyny and women's empowerment is positive in the height-for-age equation, but negative in the weight-for-height equation, and not statistically significant for weight-for-age. The sum of the two coefficients (i.e. the coefficient on women's empowerment and the coefficient on the interaction term) is positive and significant in the height-for-age equation, but negative and significant in both the weight-for-height and weight-for-age equations. In model 2, the interaction term between polygyny and the gender parity gap is statistically significant in the weight-for-age equation only, and of positive sign. The sum of the coefficients on the gender parity gap and its interaction with polygyny is also positive and significant in the weight-for-age equation, but not significantly different from zero in the other z-score equations.

Finally, in models 3 and 4, using the total number of production decisions and average number of credit decisions that women in the household participate in, respectively, the interaction term between polygyny and empowerment is significant and positive for both domains of decision-making in the height-for-age equation only. The sum of the coefficients on participation in agricultural decisions and its interaction with polygyny is positive and significant in both the height-for-age and the weight-for-height equations, although small in magnitude. The sum of the coefficients on participation in credit decisions and

its interaction with polygyny is positive and significant in the height-for-age equation, but not significant for both the weight-for-height and weight-for-age z-scores.

In monogamous households, women's empowerment indicators do not appear to directly influence any of the child anthropometric outcomes. In polygynous households, I find that the women's empowerment score is positively correlated with height-for-age z-scores but negatively correlated with weight-for-height z-scores. Surprisingly, this suggests that, in polygynous households where women are more empowered, children are less likely to suffer from chronic malnutrition contributing to impaired growth, but more likely to experience acute weight loss as a result of food shortages or illnesses. Another counterintuitive finding is that in both polygynous households with a lower gender parity gap and polygynous households with a higher women's empowerment score, children present with lower weight-for-age z-scores. Low weight-for-age z-scores can indicate both acute and chronic malnutrition, which makes their interpretation complex. Given that the 5DE score and gender parity gap are both based on a composite measure of women's empowerment along different domains, these puzzling results suggest that different aspects of women's economic and social life may have diverging influences on children's short-term and long-term health and nutritional experience.

Looking more closely at the effect of women's involvement in household decision-making, I find that women's input in decisions related to agricultural production is positively (but weakly) correlated with height-for-age and weight-for-height z-scores in polygynous households. Finally, there is strong evidence that women's input in decisions related to credit is positively correlated with height-for-age z-scores but I find no significant relationship between women's involvement in credit decisions and weight-for-height or weight-for-age z-scores.

To shed more light on the pathways that may lead to these differential nutrition outcomes, I investigate how polygyny and indicators of women's empowerment may interact and influence infant and young child feeding practices (IYCF).

Table 5.3 Effect of polygyny and women's empowerment on infant and young child feeding practices

	Exclusively breastfed (0-6 months) (1)	Dietary diversity score (6-23 months) (2)	Minimum diet diversity (6-23 months) (3)	Minimum acceptable diet (6-23 months) (4)
Model 1: 5DE empowerment score				
Polygynous HH	0.12	0.25	0.081	-0.075
	(0.31)	(0.66)	(0.18)	(0.13)
Female 5DE score	0.20	-0.36	-0.12	-0.13
	(0.21)	(0.45)	(0.13)	(0.094)
Poly * 5DE score	-0.24	-0.47	-0.22	0.031
	(0.45)	(0.94)	(0.25)	(0.18)
Effect of empowerment on children of polygynous HH:				
(5DE)+(Poly*5DE)	-0.034	-0.83	-0.34	-0.095
F-test (p-value):				
(5DE)+(Poly*5DE)=0	0.934	0.311	0.107	0.541
Child controls	Yes	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Observations	159	355	355	355
Adjusted R^2	0.117	0.161	0.085	0.18
Model 2: Gender parity gap				
Polygynous HH	0.16	-0.67	-0.27***	-0.12*
	(0.14)	(0.41)	(0.087)	(0.069)
Gender parity gap	-0.26	-0.17	0.021	0.068
	(0.25)	(0.47)	(0.14)	(0.10)
Poly * Gap	-0.32	2.14*	0.57*	0.22
	(0.38)	(1.10)	(0.28)	(0.22)
Effect of empowerment on children of polygynous HH:				
(Gap)+(Poly*Gap)	-0.580*	1.97*	0.591**	0.289
F-test (p-value):				
(Gap)+(Poly*Gap)=0	0.061	0.055	0.017	0.149
Child controls	Yes	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Observations	135	295	295	295
Adjusted R^2	0.122	0.196	0.115	0.025
Model 3: Total number of decisions related to agricultural production				
Polygynous HH	-0.026	-0.088	-0.041	-0.030
	(0.13)	(0.26)	(0.064)	(0.054)
# of production decisions	0.048***	-0.0087	-0.0035	0.0011
	(0.013)	(0.030)	(0.0085)	(0.0070)
Poly * Decisions	-0.0039	-0.0037	-0.0029	-0.011
	(0.026)	(0.059)	(0.014)	(0.012)
Effect of empowerment on children of polygynous HH: (Decisions)+(Poly*Decisions)	0.044*	-0.012	-0.006	-0.009
F-test (p-value): (Decisions)+(Poly*Decisions)=0	0.066	0.803	0.565	0.287
Child controls	Yes	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Observations	233	524	524	524
Adjusted R^2	0.128	0.164	0.078	0.038

	Exclusively breastfed (0-6 months) (1)	Dietary diversity score (6-23 months) (2)	Minimum diet diversity (6-23 months) (3)	Minimum acceptable diet (6-23 months) (4)
Model 4: Average number of decisions related to credit				
Polygynous HH	0.0092	-0.055	-0.071	-0.071*
	(0.093)	(0.21)	(0.053)	(0.043)
# of credit decisions	-0.0092	0.10	-0.020	-0.0020
	(0.044)	(0.10)	(0.030)	(0.024)
Poly * Decisions	-0.15*	-0.14	0.042	0.032
	(0.090)	(0.21)	(0.050)	(0.041)
Effect of empowerment on children of polygynous HH: (Decisions)+(Poly*Decisions)	-0.16**	-0.036	0.022	0.030
F-test (p-value): (Decisions)+(Poly*Decisions)=0	0.040	0.838	0.585	0.382
Child controls	Yes	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Observations	230	516	516	516
Adjusted R^2	0.089	0.163	0.073	0.036

Note: Robust standard errors in parentheses. Full regression results are available in Tables A.5-A.6 of the Appendix.
*** p<0.01, ** p<0.05, * p<0.1

None of the four indicators of women's empowerment appear to be correlated with IYCF practices in monogamous households, except for women's participation in decisions related to agricultural production, which is positively associated with the likelihood of exclusively breastfeeding infants under 6 months (Table 5.3). In polygynous households, I find no statistically significant relationship between women's empowerment score and any of the feeding practices that are examined. Thus, the opposite effects of women's empowerment score on children's height-for-age scores, on the one hand, and weight-for-height and weight-for-age scores, on the other hand, are not easily explained by their diet characteristics in the past week. I also find that children in polygynous households with lower gender parity gaps are less likely to be fed a diverse diet, which may contribute to the association between gender parity gaps and weight-for-age z-scores (that is, the lower the gender gap, the lower the child's weight-for-age z-score). While the sign of the relationship may seem counterintuitive, it is consistent with qualitative findings by Davis et al. (2003) – also cited in Malapit and Quisumbing (2015) – that suggest that more malnourished children are often fed a more diverse diet, to compensate for their poor appetite. In polygynous households where women participate in decisions related to agricultural production, infants under 6 months are more likely to be exclusively breastfed, which is consistent with the positive association between women's involvement in agricultural decisions and both height-for-age and weight-for-height z-scores. In contrast,

the positive correlation between women's involvement in polygynous households' credit decisions and height-for-age z-scores of children under the age of 5 appear to be in contradiction with the negative relationship between credit decision-making and exclusive breastfeeding. However, the practice of exclusive breastfeeding, only captured for infants under 6 months, may not significantly affect the nutritional status of older children, and may also be less sensitive to women's ability to use credit for consumption smoothing.

Mother's rank, nutrition outcomes and feeding practices

To explore whether children's diet quality and nutritional status may be influenced by the mother's rank among co-wives, I restrict the sample to children 0 to 23 months in polygynous households and estimate the regression model in Equation (3). The results in Table 5.4 suggest that senior wives are more likely to practice exclusive breastfeeding, relative to junior wives. I find no evidence that a mother's rank is correlated with diet quality of children 6-23 months in polygynous households.

Table 5.4 Effect of mother's rank on IYCF practices of children 0 to 23 months in polygynous households

	Exclusively breastfed (0-6 months) (1)	Dietary diversity score (6-23 months) (2)	Minimum diet diversity (6-23 months) (3)	Minimum acceptable diet (6-23 months) (4)
Mother is Senior wife	0.22*	-0.41	-0.074	-0.0053
	(0.13)	(0.28)	(0.067)	(0.057)
Child controls	Yes	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Observations	84	165	165	165
Adjusted R^2	0.031	0.142	0.166	0.039

Note: Robust standard errors in parentheses. Full regression results are available in Table A.7 of the Appendix.
*** p<0.01, ** p<0.05, * p<0.1

The results in Table 5.5 show that having a mother who is a senior wife is positively correlated with height-for-age z-scores and negatively correlated with weight-for-height z-scores. The senior wife in a polygynous household, compared to junior co-wives, may be better able to protect her children from chronic malnutrition and recurrent infections than to keep them from experiencing acute food shortages or illness episodes. Indeed, the lack of significant correlation between a mother's senior-wife status and the quality of her children's diet suggests that factors other than food availability (such as the ability to seek health

care, for example) may be influencing the nutritional status of senior wives' children and junior wives' children differentially.

Table 5.5 Effect of mother's rank on nutritional status of children 0 to 23 months in polygynous households

	Height-for-age (1)	Weight-for-height (2)	Weight-for-age (3)
Mother is Senior wife	0.68*	-0.56*	0.10
	(0.35)	(0.30)	(0.26)
Child controls	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes
Household controls	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes
Observations	222	212	227
Adjusted R2	0.227	0.089	0.231

Note: Robust standard errors in parentheses. Full regression results are available in Table A.7 of the Appendix.
*** p<0.01, ** p<0.05, * p<0.1

6. CONCLUSION

Using observational data provided by the 2012 Feed the Future Ghana Population-based survey, I study the effect of polygyny on child nutrition outcomes and the potential mitigating role of women's empowerment and mother's rank. While children under the age of five in polygynous households may present lower weight-for-height z-scores compared to children of monogamous couples even after controlling for important confounding factors including household size, composition and wealth, I find no such relationship with height-for-age or weight-for age z-scores. Careful examination of the interaction between polygyny and women's empowerment suggests that: (1) different dimensions of empowerment may have different impacts on child nutritional status and feeding practices, which is consistent with the findings of Malapit and Quisumbing (2015), and (2) women's empowerment in agriculture may affect child nutrition outcomes differentially in polygynous households versus monogamous households. Finally, while I find that, in polygynous households, senior wives are more likely to practice exclusive breastfeeding relative to younger wives, the effect of a mother's rank on her children's diet quality and nutritional status is ambiguous.

Whether the WEAI toolkit is used to measure women's empowerment in agriculture as a baseline indicator or as a project outcome, particular attention should be given to understanding its meaning and implications in polygynous households (and more generally, in households with multiple female decision-makers). For instance, while I have found that female WEAI respondents are less likely to be empowered in polygynous households, it should be noted that there is no statistically significant difference in the 5DE empowerment score of male WEAI respondents in monogamous and polygynous households[10]. This suggests that decision-making authority may be shared between co-wives in polygynous households, especially in the domains of agricultural production and credit, which I have shown to be driving the difference in empowerment between polygynous wives and their monogamous counterparts. Indeed, the extent to which polygyny is likely to result in the division of decision-making authority

[10] A detailed comparison of male WEAI indicators in monogamous and polygynous households is available upon request.

among co-wives in specific dimensions of empowerment versus others (such as asset ownership and control) may contribute to some of the apparent disparity in my results.

Moreover, the ambiguous effect of co-wife seniority on children's nutrition outcomes may point to the importance of unobserved mother's characteristics in the analysis sample. While I originally hypothesize that a co-wife's rank – that is, the order in which she married the polygynous husband (proxied by her age) – is indicative of her bargaining power within the household, in certain contexts, other individual traits that are not captured in the survey may be stronger predictors of her decision-making authority and, in turn, of her children's outcomes. Future research in this direction would not only benefit from interviews of multiple female WEAI respondents within the same household but also from data collection efforts designed to capture a polygynous wife's "outside option" through measures of labor productivity, individual assets, or even competition in marriage markets.

The empirical approach I adopt in this paper presents a number of limitations. Because of endogeneity concerns related to unobservable characteristics that may drive individuals and households to self-select into polygyny, I cannot claim to identify causal relationships. In the absence of suitable instruments for polygyny, another way to address issues of unobserved household characteristics would be to use a household fixed effects model, but this would require more variation within household (e.g. in marital status or mother's rank). While the original sample size in the Ghana Feed the Future Population-Based Survey (PBS) may seem reasonably large, mothers or caregiver are, in fact, only matched with their children under two, which substantially reduces the number of observations that can be leveraged to analyze relationships between co-wives or between household types. Weather shocks can also provide a useful source of exogenous variation in income, but the narrow age range (i.e. 0 through 23 months) available for analysis limits the feasibility of such approaches.

The potential for heterogeneity in the vulnerability of children in polygynous households to acute and/or prolonged periods of nutritional and health distress, such as those triggered by extreme weather shocks, has important implications for policy design. In particular, understanding the role of women's empowerment – both relative to monogamous households and between the different co-wives – and

developing more adequate targeting strategies to maximize the impact of resilience-building and empowerment programs, constitutes a crucial step in improving both child's and woman's outcomes in areas where polygyny is common.

APPENDIX

Table A.1 Full results: Effect of polygyny on nutritional status of children 0 to 59 months

	Height-for-age z-score	Weight-for-height z-score	Weight-for-age z-score
Polygynous HH	0.040	-0.26***	-0.021
	(0.10)	(0.087)	(0.081)
Child characteristics			
Child age (months)	-0.12***	0.0090	-0.053***
	(0.010)	(0.0080)	(0.0075)
Child age, squared	0.0015***	0.000094	0.00082***
	(0.00017)	(0.00013)	(0.00013)
Child sex: Male	-0.16**	0.067	-0.046
	(0.076)	(0.064)	(0.057)
Household characteristics			
HH head age	-0.016	-0.0068	-0.0093
	(0.014)	(0.012)	(0.011)
HH head age, squared	0.00021	0.000085	0.000083
	(0.00014)	(0.00012)	(0.00011)
Household size	0.017	-0.0032	0.016
	(0.014)	(0.012)	(0.011)
Total dependency ratio	-0.026	0.092**	0.11**
	(0.060)	(0.045)	(0.043)
Location: Rural	-0.29***	-0.033	-0.15*
	(0.11)	(0.089)	(0.078)
Per-capita expenditure quintile 1	0.064	-0.13	-0.15
	(0.16)	(0.13)	(0.12)
Per-capita expenditure quintile 2	-0.027	0.069	0.059
	(0.15)	(0.12)	(0.12)
Per-capita expenditure quintile 3	-0.055	-0.024	0.022
	(0.15)	(0.12)	(0.12)
Per-capita expenditure quintile 4	0.21	-0.013	0.15
	(0.15)	(0.12)	(0.11)
Region: Northern	-0.12	-0.061	0.0080
	(0.12)	(0.10)	(0.087)
Region: Upper East	0.068	-0.33**	-0.10
	(0.15)	(0.13)	(0.11)
Region: Upper West	0.33**	-0.098	0.22*
	(0.17)	(0.14)	(0.12)
Constant	0.88**	-0.35	-0.077
	(0.38)	(0.33)	(0.30)
Observations	2,876	2,754	2,957
Adjusted R^2	0.090	0.025	0.024

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.2 Full results: Effect of polygyny and women's empowerment on nutritional status of children 0 to 59 months (height-for-age z-score)

	Height-for-age z-score							
	Model 1: 5DE empowerment score		Model 2: Gender parity gap		Model 3: Total number of decisions related to agricultural production		Model 4: Average number of decisions related to credit	
Polygynous HH	-0.028	0.88**	-0.082	0.0017	0.011	-0.23	0.042	-0.11
	(0.15)	(0.42)	(0.16)	(0.27)	(0.12)	(0.16)	(0.12)	(0.13)
Women's empowerment indicators								
Female 5DE score		-0.25						
		(0.30)						
Poly * 5DE score		1.27**						
		(0.61)						
Gender parity gap				-0.37				
				(0.32)				
Poly * Gap				-0.30				
				(0.69)				
# of ag. production decisions						-0.027		
						(0.020)		
Poly * Ag. decisions						0.078**		
						(0.037)		
# of credit decisions								-0.076
								(0.065)
Poly * Cred. decisions								0.41***
								(0.13)
Child characteristics								
Child age (months)	-0.091***	-0.092***	-0.081***	-0.082***	-0.10***	-0.10***	-0.10***	-0.10***
	(0.015)	(0.015)	(0.016)	(0.016)	(0.012)	(0.012)	(0.012)	(0.012)
Child age, squared	0.0011***	0.0011***	0.00096***	0.00099***	0.0012***	0.0012***	0.0012***	0.0012***
	(0.00024)	(0.00024)	(0.00026)	(0.00026)	(0.00020)	(0.00020)	(0.00020)	(0.00020)
Child sex: Male	-0.18*	-0.18*	-0.16	-0.16	-0.15	-0.14	-0.15	-0.15*
	(0.11)	(0.11)	(0.12)	(0.12)	(0.089)	(0.089)	(0.090)	(0.090)
Household characteristics								
HH head age	-0.039*	-0.040*	-0.028	-0.030	-0.015	-0.014	-0.013	-0.013
	(0.023)	(0.024)	(0.026)	(0.026)	(0.017)	(0.017)	(0.017)	(0.017)
HH head age, squared	0.00049**	0.00050**	0.00036	0.00037	0.00022	0.00022	0.00021	0.00021
	(0.00024)	(0.00024)	(0.0026)	(0.00027)	(0.00016)	(0.00016)	(0.00017)	(0.00017)
Household size	0.0041	0.0065	0.021	0.020	0.0058	0.0053	0.0022	0.0032
	(0.020)	(0.019)	(0.024)	(0.024)	(0.016)	(0.016)	(0.016)	(0.016)
Total dependency ratio	-0.046	-0.047	-0.036	-0.041	-0.087	-0.078	-0.071	-0.084
	(0.083)	(0.082)	(0.094)	(0.093)	(0.066)	(0.067)	(0.069)	(0.067)
Per-capita expenditure quintile 1	0.052	0.055	-0.087	-0.041	0.12	0.088	0.057	0.048
	(0.26)	(0.26)	(0.28)	(0.28)	(0.20)	(0.20)	(0.20)	(0.21)
Per-capita expenditure quintile 2	-0.12	-0.12	-0.30	-0.27	-0.047	-0.070	-0.11	-0.10
	(0.25)	(0.25)	(0.27)	(0.27)	(0.19)	(0.20)	(0.20)	(0.20)
Per-capita expenditure quintile 3	-0.074	-0.053	-0.22	-0.18	-0.055	-0.073	-0.13	-0.14
	(0.24)	(0.24)	(0.26)	(0.26)	(0.19)	(0.19)	(0.19)	(0.20)
Per-capita expenditure quintile 4	-0.048	-0.029	-0.088	-0.055	0.090	0.073	0.033	0.013
	(0.24)	(0.24)	(0.26)	(0.26)	(0.19)	(0.19)	(0.19)	(0.19)
Region: Northern	-0.19	-0.19	-0.23	-0.19	-0.13	-0.12	-0.17	-0.19
	(0.18)	(0.18)	(0.21)	(0.21)	(0.16)	(0.16)	(0.16)	(0.16)
Region: Upper East	-0.25	-0.24	-0.35	-0.36	-0.12	-0.10	-0.14	-0.17
	(0.22)	(0.22)	(0.25)	(0.25)	(0.19)	(0.19)	(0.20)	(0.19)
Region: Upper West	0.30	0.29	0.32	0.31	0.20	0.21	0.15	0.15
	(0.24)	(0.24)	(0.27)	(0.27)	(0.21)	(0.21)	(0.21)	(0.21)
Constant	1.03*	1.20**	0.70	0.81	0.70	0.76*	0.74*	0.79*
	(0.59)	(0.61)	(0.65)	(0.66)	(0.44)	(0.44)	(0.45)	(0.45)
Observations	1,366	1,366	1,145	1,145	2,022	2,022	1,983	1,983
Adjusted R^2	0.077	0.079	0.062	0.062	0.091	0.092	0.091	0.096

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.3 Full results: Effect of polygyny and women's empowerment on nutritional status of children 0 to 59 months (weight-for-height z-score)

	Weight-for-height z-score							
	Model 1: 5DE empowerment score		Model 2: Gender parity gap		Model 3: Total number of decisions related to agricultural production		Model 4: Average number of decisions related to credit	
Polygynous HH	-0.34***	0.34	-0.43***	-0.65***	-0.34***	-0.49***	-0.35***	-0.29***
	(0.12)	(0.37)	(0.14)	(0.21)	(0.099)	(0.15)	(0.10)	(0.11)
Women's empowerment indicators								
Female 5DE score		0.15						
		(0.25)						
Poly * 5DE score		-1.02**						
		(0.51)						
Gender parity gap				-0.35				
				(0.27)				
Poly * Gap				0.75				
				(0.63)				
# of ag. production decisions						-0.0017		
						(0.018)		
Poly * Ag. decisions						0.048		
						(0.032)		
# of credit decisions								0.078
								(0.060)
Poly * Cred. decisions								-0.17
								(0.11)
Child characteristics								
Child age (months)	0.00076	0.0016	-0.0079	-0.0076	0.0094	0.0091	0.0092	0.0091
	(0.011)	(0.011)	(0.012)	(0.012)	(0.0095)	(0.0095)	(0.0096)	(0.0096)
Child age, squared	0.00017	0.00015	0.00031	0.00031	0.000091	0.000096	0.000088	0.000085
	(0.00019)	(0.00019)	(0.00020)	(0.00020)	(0.00016)	(0.00016)	(0.00016)	(0.00016)
Child sex: Male	0.19**	0.19**	0.25**	0.25**	0.067	0.067	0.077	0.073
	(0.090)	(0.090)	(0.099)	(0.099)	(0.075)	(0.075)	(0.076)	(0.076)
Household characteristics								
HH head age	0.012	0.013	0.014	0.014	-0.0082	-0.0089	-0.0085	-0.0092
	(0.019)	(0.019)	(0.021)	(0.020)	(0.014)	(0.014)	(0.014)	(0.014)
HH head age, squared	-0.00012	-0.00014	-0.000097	-0.00010	0.000085	0.000093	0.000099	0.00011
	(0.00019)	(0.00019)	(0.00020)	(0.00020)	(0.00014)	(0.00014)	(0.00014)	(0.00014)
Household size	-0.016	-0.017	-0.025	-0.025	0.0070	0.0063	0.0072	0.0066
	(0.018)	(0.018)	(0.021)	(0.021)	(0.014)	(0.014)	(0.014)	(0.014)
Total dependency ratio	0.042	0.039	0.047	0.046	0.097*	0.10**	0.092*	0.094*
	(0.062)	(0.062)	(0.064)	(0.064)	(0.052)	(0.052)	(0.053)	(0.053)
Per-capita expenditure quintile 1	0.18	0.17	0.29	0.32	-0.17	-0.17	-0.15	-0.14
	(0.19)	(0.19)	(0.20)	(0.21)	(0.15)	(0.15)	(0.15)	(0.15)
Per-capita expenditure quintile 2	0.20	0.20	0.23	0.25	0.067	0.071	0.093	0.095
	(0.17)	(0.17)	(0.18)	(0.18)	(0.14)	(0.14)	(0.14)	(0.14)
Per-capita expenditure quintile 3	0.036	0.016	0.063	0.071	-0.048	-0.045	-0.044	-0.037
	(0.16)	(0.16)	(0.18)	(0.18)	(0.14)	(0.14)	(0.14)	(0.14)
Per-capita expenditure quintile 4	0.12	0.10	0.12	0.13	0.051	0.050	0.086	0.092
	(0.16)	(0.16)	(0.18)	(0.18)	(0.13)	(0.14)	(0.14)	(0.14)
Region: Northern	-0.096	-0.098	-0.20	-0.18	-0.011	-0.0047	0.016	0.022
	(0.16)	(0.16)	(0.18)	(0.18)	(0.14)	(0.14)	(0.14)	(0.14)
Region: Upper East	-0.20	-0.20	-0.11	-0.13	-0.19	-0.19	-0.15	-0.15
	(0.19)	(0.19)	(0.20)	(0.20)	(0.17)	(0.17)	(0.17)	(0.17)
Region: Upper West	-0.021	-0.020	-0.068	-0.066	0.12	0.13	0.15	0.14
	(0.20)	(0.20)	(0.22)	(0.22)	(0.17)	(0.17)	(0.18)	(0.18)
Constant	-0.62	-0.73	-0.58	-0.51	-0.48	-0.47	-0.52	-0.54
	(0.49)	(0.50)	(0.53)	(0.53)	(0.38)	(0.38)	(0.38)	(0.38)
Observations	1,311	1,311	1,103	1,103	1,949	1,949	1,919	1,919
Adjusted R^2	0.017	0.019	0.028	0.028	0.026	0.026	0.026	0.026

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4 Full results: Effect of polygyny and women's empowerment on nutritional status of children 0 to 59 months (weight-for-age z-score)

	Weight-for-age z-score							
	Model 1: 5DE empowerment score		Model 2: Gender parity gap		Model 3: Total number of decisions related to agricultural production		Model 4: Average number of decisions related to credit	
Polygynous HH	-0.067	0.40	-0.078	-0.47**	-0.081	-0.17	-0.11	-0.13
	(0.11)	(0.36)	(0.12)	(0.19)	(0.091)	(0.14)	(0.091)	(0.099)
Women's empowerment indicators								
Female 5DE score		-0.19						
		(0.22)						
Poly * 5DE score		-0.69						
		(0.50)						
Gender parity gap				-0.28				
				(0.24)				
Poly * Gap				1.35**				
				(0.59)				
# of ag. production decisions						-0.017		
						(0.014)		
Poly * Ag. decisions						0.029		
						(0.029)		
# of credit decisions								-0.021
								(0.051)
Poly * Cred. decisions								0.047
								(0.10)
Child characteristics								
Child age (months)	-0.045***	-0.044***	-0.051***	-0.050***	-0.049***	-0.050***	-0.050***	-0.050***
	(0.011)	(0.011)	(0.012)	(0.011)	(0.0086)	(0.0086)	(0.0087)	(0.0087)
Child age, squared	0.00065***	0.00063***	0.00073***	0.00070***	0.00071***	0.00072***	0.00071***	0.00071***
	(0.00018)	(0.00018)	(0.00019)	(0.00019)	(0.00014)	(0.00014)	(0.00014)	(0.00014)
Child sex: Male	-0.0029	-0.0031	0.085	0.083	-0.038	-0.038	-0.032	-0.031
	(0.082)	(0.082)	(0.089)	(0.089)	(0.067)	(0.067)	(0.067)	(0.067)
Household characteristics								
HH head age	-0.0012	0.0023	0.012	0.015	-0.0039	-0.0028	-0.0037	-0.0035
	(0.016)	(0.016)	(0.018)	(0.018)	(0.013)	(0.013)	(0.013)	(0.013)
HH head age, squared	-0.000015	-0.000048	-0.00011	-0.00014	0.000019	0.0000091	0.000028	0.000026
	(0.00016)	(0.00016)	(0.00018)	(0.00018)	(0.00013)	(0.00013)	(0.00013)	(0.00013)
Household size	0.023	0.022	0.00067	0.0011	0.033**	0.033**	0.030**	0.031**
	(0.017)	(0.016)	(0.017)	(0.017)	(0.013)	(0.013)	(0.013)	(0.013)
Total dependency ratio	0.027	0.031	0.041	0.044	0.037	0.040	0.034	0.034
	(0.058)	(0.059)	(0.063)	(0.0640)	(0.046)	(0.046)	(0.047)	(0.046)
Per-capita expenditure quintile 1	-0.10	-0.12	-0.017	-0.016	-0.28*	-0.30**	-0.20	-0.20
	(0.17)	(0.17)	(0.19)	(0.19)	(0.14)	(0.14)	(0.14)	(0.14)
Per-capita expenditure quintile 2	-0.078	-0.084	-0.0013	0.0053	-0.10	-0.12	-0.028	-0.029
	(0.17)	(0.17)	(0.18)	(0.18)	(0.14)	(0.14)	(0.14)	(0.14)
Per-capita expenditure quintile 3	-0.030	-0.051	0.022	0.0086	-0.13	-0.14	-0.083	-0.086
	(0.17)	(0.17)	(0.18)	(0.18)	(0.14)	(0.14)	(0.14)	(0.14)
Per-capita expenditure quintile 4	0.032	0.020	0.11	0.10	0.024	0.015	0.11	0.10
	(0.16)	(0.16)	(0.18)	(0.17)	(0.14)	(0.14)	(0.13)	(0.13)
Region: Northern	-0.034	-0.067	-0.13	-0.13	0.012	0.016	-0.00053	-0.0025
	(0.12)	(0.12)	(0.13)	(0.13)	(0.11)	(0.11)	(0.11)	(0.11)
Region: Upper East	-0.080	-0.086	-0.074	-0.090	-0.051	-0.038	-0.060	-0.062
	(0.16)	(0.16)	(0.17)	(0.17)	(0.14)	(0.14)	(0.14)	(0.14)
Region: Upper West	0.22	0.22	0.19	0.19	0.30*	0.30*	0.28*	0.28*
	(0.18)	(0.18)	(0.18)	(0.18)	(0.16)	(0.16)	(0.16)	(0.16)
Constant	-0.31	-0.23	-0.49	-0.50	-0.25	-0.22	-0.30	-0.30
	(0.41)	(0.42)	(0.45)	(0.45)	(0.34)	(0.34)	(0.34)	(0.34)
Observations	1,406	1,406	1,172	1,172	2,086	2086	2,050	2,050
Adjusted R^2	0.012	0.015	0.019	0.023	0.024	0.024	0.024	0.024

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.5 Full results: Effect of polygyny and women's empowerment on IYCF practices (exclusive breastfeeding, 0-6 months; dietary diversity score, 6-23 months)

	Exclusive Breastfeeding (0-6 months)				Dietary Diversity Score (6-23 months)			
	Model 1: 5DE score	Model 2: Gender parity gap	Model 3: Ag. decisions	Model 4: Credit decisions	Model 1: 5DE score	Model 2: Gender parity gap	Model 3: Ag. decisions	Model 4: Credit decisions
Polygynous HH	0.12	0.16	-0.026	0.0092	0.25	-0.67	-0.088	-0.055
	(0.31)	(0.14)	(0.13)	(0.093)	(0.66)	(0.41)	(0.26)	(0.21)
Women's empowerment indicators								
Female 5DE score	0.20				-0.36			
	(0.21)				(0.45)			
Poly * 5DE score	-0.24				-0.47			
	(0.45)				(0.94)			
Gender parity gap		-0.26				-0.17		
		(0.25)				(0.47)		
Poly * Gap		-0.32				2.14*		
		(0.38)				(1.10)		
# of ag. production decisions			0.048***				-0.0087	
			(0.013)				(0.030)	
Poly * Ag. decisions			-0.0039				-0.0037	
			(0.026)				(0.059)	
# of credit decisions				-0.0092				0.10
				(0.044)				(0.10)
Poly * Cred. decisions				-0.15*				-0.14
				(0.090)				(0.21)
Child characteristics								
Child age (months)	-0.029	-0.041	-0.015	0.017	0.42***	0.39***	0.38***	0.39***
	(0.084)	(0.089)	(0.070)	(0.072)	(0.10)	(0.11)	(0.079)	(0.080)
Child age, squared	-0.017	-0.014	-0.017	-0.021	-0.0098***	-0.0085**	-0.0088***	-0.0091***
	(0.016)	(0.017)	(0.013)	(0.014)	(0.0036)	(0.0038)	(0.0028)	(0.0028)
Child sex: Male	-0.026	-0.027	-0.070	-0.056	-0.066	-0.039	-0.028	-0.048
	(0.083)	(0.091)	(0.064)	(0.066)	(0.16)	(0.18)	(0.13)	(0.13)
Mother characteristics								
Mother age	0.0051	-0.0095	-0.024	-0.016	-0.10	-0.16	-0.078	-0.090
	(0.048)	(0.047)	(0.033)	(0.035)	(0.12)	(0.14)	(0.086)	(0.090)
Mother age, squared	0.000045	0.00033	0.00049	0.00032	0.0019	0.0031	0.0015	0.0017
	(0.00076)	(0.00071)	(0.00055)	(0.00057)	(0.0020)	(0.0022)	(0.0014)	(0.0014)
Mother height (cm)	0.0048	0.0041	0.0058	0.0065	-0.012	-0.025**	-0.0024	-0.0035
	(0.0060)	(0.0064)	(0.0040)	(0.0041)	(0.0098)	(0.011)	(0.0081)	(0.0083)
Mother can read and write	0.032	-0.011	-0.046	0.022	-0.11	-0.15	0.092	0.025
	(0.17)	(0.17)	(0.14)	(0.14)	(0.34)	(0.36)	(0.28)	(0.29)
Household characteristics								
HH head age	-0.013	-0.024	-0.015	-0.0050	0.015	-0.051	0.015	0.017
	(0.017)	(0.018)	(0.013)	(0.012)	(0.038)	(0.050)	(0.032)	(0.032)
HH head age, squared	0.00013	0.00022	0.00013	0.000050	-0.00028	0.00040	-0.00018	-0.00022
	(0.00016)	(0.00017)	(0.00012)	(0.00011)	(0.00038)	(0.00051)	(0.00033)	(0.00034)
Household size	0.018	0.022	0.013	0.013	-0.030	-0.047	-0.0054	-0.00054
	(0.013)	(0.014)	(0.011)	(0.012)	(0.026)	(0.030)	(0.021)	(0.022)
Total dependency ratio	-0.15**	-0.16**	-0.050	-0.030	0.073	0.23	-0.086	-0.078
	(0.065)	(0.070)	(0.049)	(0.052)	(0.12)	(0.16)	(0.097)	(0.096)
Per-capita expenditure quintile 1	0.17	0.24*	0.17	0.16	0.29	0.48	-0.089	-0.082
	(0.13)	(0.14)	(0.12)	(0.12)	(0.44)	(0.43)	(0.37)	(0.38)
Per-capita expenditure quintile 2	0.044	0.034	0.14	0.10	0.43	0.60	0.081	0.071
	(0.15)	(0.17)	(0.12)	(0.13)	(0.44)	(0.42)	(0.37)	(0.38)
Per-capita expenditure quintile 3	-0.093	0.038	0.063	0.051	0.41	0.34	0.19	0.21
	(0.15)	(0.16)	(0.12)	(0.13)	(0.44)	(0.43)	(0.37)	(0.38)
Per-capita expenditure quintile 4	0.098	0.14	0.089	0.094	0.57	0.66	0.39	0.39
	(0.16)	(0.17)	(0.13)	(0.14)	(0.44)	(0.43)	(0.37)	(0.37)
Region: Northern	-0.029	0.082	0.031	0.091	-0.014	-0.10	0.10	0.096
	(0.16)	(0.18)	(0.12)	(0.13)	(0.29)	(0.30)	(0.25)	(0.25)
Region: Upper East	-0.19	-0.012	-0.20	-0.12	0.20	0.30	0.14	0.10
	(0.19)	(0.20)	(0.15)	(0.15)	(0.37)	(0.39)	(0.32)	(0.32)
Region: Upper West	-0.065	0.030	-0.023	0.00041	0.25	0.51	0.27	0.26
	(0.19)	(0.20)	(0.16)	(0.16)	(0.40)	(0.40)	(0.35)	(0.35)
Constant	0.19	0.76	0.32	-0.090	1.70	5.46**	-0.17	0.055
	(0.96)	(0.97)	(0.77)	(0.81)	(2.42)	(2.74)	(1.84)	(1.88)
Observations	159	135	233	230	355	295	524	516
Adjusted R^2	0.117	0.122	0.128	0.089	0.161	0.196	0.164	0.163

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.6 Full results: Effect of polygyny and women's empowerment on IYCF practices (minimum diet diversity, 6-23 months; minimum acceptable diet, 6-23 months)

	Minimum Diet Diversity (6-23 months)				Minimum Acceptable Diet (6-23 months)			
	Model 1: 5DE score	Model 2: Gender parity gap	Model 3: Ag. decisions	Model 4: Credit decisions	Model 1: 5DE score	Model 2: Gender parity gap	Model 3: Ag. decisions	Model 4: Credit decisions
Polygynous HH	0.081	-0.27***	-0.041	-0.071	-0.075	-0.12*	-0.030	-0.071*
	(0.18)	(0.087)	(0.064)	(0.053)	(0.13)	(0.069)	(0.054)	(0.043)
Women's empowerment indicators								
Female 5DE score	-0.12				-0.13			
	(0.13)				(0.094)			
Poly * 5DE score	-0.22				0.031			
	(0.25)				(0.18)			
Gender parity gap		0.021				0.068		
		(0.14)				(0.10)		
Poly * Gap		0.57**				0.22		
		(0.28)				(0.22)		
# of ag. production decisions			-0.0035				0.0011	
			(0.0085)				(0.0070)	
Poly * Ag. decisions			-0.0029				-0.011	
			(0.014)				(0.012)	
# of credit decisions				-0.020				-0.0020
				(0.030)				(0.024)
Poly * Cred. decisions				0.042				0.032
				(0.050)				(0.041)
Child characteristics								
Child age (months)	0.054*	0.060*	0.039*	0.040*	0.0094	0.0048	0.014	0.012
	(0.029)	(0.032)	(0.023)	(0.023)	(0.024)	(0.028)	(0.019)	(0.019)
Child age, squared	-0.0011	-0.0012	-0.00066	-0.00073	-0.00018	-0.0000027	-0.00033	-0.00026
	(0.0011)	(0.0012)	(0.00085)	(0.00086)	(0.00089)	(0.0010)	(0.00070)	(0.00070)
Child sex: Male	-0.033	-0.027	-0.027	-0.028	-0.014	-0.0012	-0.020	-0.022
	(0.048)	(0.053)	(0.037)	(0.038)	(0.039)	(0.044)	(0.031)	(0.031)
Mother characteristics								
Mother age	-0.026	-0.058	-0.034	-0.027	-0.046	-0.054	-0.044**	-0.034*
	(0.033)	(0.037)	(0.024)	(0.025)	(0.028)	(0.033)	(0.021)	(0.021)
Mother age, squared	0.00051	0.0011*	0.00062	0.00051	0.00081*	0.00092*	0.00080**	0.00062*
	(0.00053)	(0.00060)	(0.00039)	(0.00040)	(0.00046)	(0.00054)	(0.00035)	(0.00034)
Mother height (cm)	-0.0035	-0.0045	-0.0025	-0.0029	-0.0045*	-0.0047	-0.0028	-0.0033*
	(0.0029)	(0.0035)	(0.0022)	(0.0023)	(0.0024)	(0.0029)	(0.0018)	(0.0018)
Mother can read and write	0.044	0.016	0.074	0.049	-0.017	-0.053	-0.019	-0.039
	(0.10)	(0.10)	(0.084)	(0.085)	(0.077)	(0.080)	(0.058)	(0.057)
Household characteristics								
HH head age	0.0014	-0.015	0.0039	0.0032	0.0059	-0.0021	0.0010	0.00025
	(0.0099)	(0.013)	(0.0080)	(0.0080)	(0.0081)	(0.012)	(0.0067)	(0.0069)
HH head age, squared	-0.000025	0.00013	-0.000034	-0.000031	-0.000072	0.000020	-0.000018	-0.0000033
	(0.00010)	(0.00014)	(0.000081)	(0.000082)	(0.000083)	(0.00012)	(0.000067)	(0.000071)
Household size	-0.0044	-0.0012	-0.0047	-0.0033	-0.0028	-0.0020	0.00038	-0.00031
	(0.0053)	(0.0063)	(0.0051)	(0.0050)	(0.0040)	(0.0051)	(0.0044)	(0.0044)
Total dependency ratio	-0.040	-0.027	-0.052**	-0.054**	-0.028	-0.023	-0.042**	-0.044**
	(0.035)	(0.045)	(0.026)	(0.025)	(0.027)	(0.036)	(0.020)	(0.020)
Per-capita expenditure quintile 1	-0.034	0.018	-0.088	-0.085	0.025	0.082	-0.011	-0.0030
	(0.10)	(0.097)	(0.085)	(0.088)	(0.071)	(0.065)	(0.059)	(0.061)
Per-capita expenditure quintile 2	0.031	0.092	-0.0086	-0.0067	0.050	0.074	0.039	0.049
	(0.10)	(0.099)	(0.086)	(0.089)	(0.074)	(0.069)	(0.062)	(0.065)
Per-capita expenditure quintile 3	0.033	0.057	0.0031	0.0077	0.061	0.10	0.049	0.054
	(0.11)	(0.11)	(0.089)	(0.092)	(0.075)	(0.068)	(0.063)	(0.065)
Per-capita expenditure quintile 4	0.083	0.084	0.049	0.052	0.15*	0.20***	0.12*	0.13*
	(0.10)	(0.10)	(0.088)	(0.091)	(0.076)	(0.071)	(0.064)	(0.066)
Region: Northern	-0.067	-0.072	-0.018	-0.020	0.051	0.028	0.076	0.078
	(0.086)	(0.092)	(0.076)	(0.076)	(0.064)	(0.071)	(0.056)	(0.056)
Region: Upper East	0.053	0.068	0.044	0.033	0.030	0.021	0.031	0.024
	(0.10)	(0.11)	(0.090)	(0.091)	(0.072)	(0.081)	(0.062)	(0.061)
Region: Upper West	0.16	0.22*	0.13	0.13	0.13	0.15	0.16**	0.16**
	(0.11)	(0.12)	(0.098)	(0.099)	(0.092)	(0.10)	(0.078)	(0.078)
Constant	0.81	1.57*	0.75	0.73	1.30**	1.53**	0.98**	0.96**
	(0.67)	(0.84)	(0.50)	(0.51)	(0.57)	(0.73)	(0.42)	(0.43)
Observations	355	295	524	516	355	295	524	516
Adjusted R^2	0.085	0.115	0.078	0.073	0.018	0.025	0.038	0.036

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.7 Full results: Effect of mother's rank on IYCF practices and child nutrition status in polygynous households

	Dependent variables:						
	Exclusive Breastfeeding (0-6 months)	Dietary Diversity Score (6-23 months)	Minimum Diet Diversity (6-23 months)	Minimum Acceptable Diet (6-23 months)	Height-for-age z-score (0-23 months)	Weight-for-height z-score (0-23 months)	Weight-for-age z-score (0-23 months)
Mother is Senior wife	0.22*	-0.41	-0.074	-0.0053	0.68*	-0.56*	0.10
	(0.13)	(0.28)	(0.067)	(0.057)	(0.35)	(0.30)	(0.26)
Child characteristics							
Child age (months)	0.046	0.064	-0.043	-0.049	-0.31***	-0.11	-0.34***
	(0.12)	(0.15)	(0.039)	(0.035)	(0.096)	(0.074)	(0.070)
Child age, squared	-0.027	0.0025	0.0022	0.0018	0.0054	0.0050	0.0100***
	(0.023)	(0.0052)	(0.0014)	(0.0013)	(0.0040)	(0.0033)	(0.0028)
Child sex: Male	-0.13	0.12	0.023	0.0042	-0.69**	-0.12	-0.23
	(0.11)	(0.25)	(0.058)	(0.049)	(0.30)	(0.24)	(0.23)
Mother characteristics							
Mother age	-0.16**	-0.18	-0.072*	-0.049	-0.15	0.15	0.079
	(0.077)	(0.16)	(0.039)	(0.031)	(0.21)	(0.16)	(0.14)
Mother age, squared	0.0021*	0.0034	0.0013**	0.00090*	0.0020	-0.0016	-0.0012
	(0.0011)	(0.0024)	(0.00062)	(0.00051)	(0.0034)	(0.0025)	(0.0020)
Mother height (cm)	0.011	-0.0058	-0.0032	-0.0012	0.011	0.031**	0.0099
	(0.0082)	(0.014)	(0.0029)	(0.0026)	(0.018)	(0.013)	(0.013)
Mother can read and write	-0.12	-0.015	0.042	0.13	0.45	-0.50	-0.099
	(0.32)	(0.54)	(0.13)	(0.14)	(0.60)	(0.71)	(0.58)
Household characteristics							
HH head age	0.040	-0.0021	-0.0066	-0.0074	0.039	-0.097*	-0.077
	(0.036)	(0.066)	(0.016)	(0.013)	(0.078)	(0.055)	(0.058)
HH head age, squared	-0.00026	-0.000011	0.000070	0.000067	-0.00015	0.00059	0.00064
	(0.00034)	(0.00066)	(0.00015)	(0.00013)	(0.00074)	(0.00052)	(0.00052)
Household size	0.0063	-0.010	0.0039	0.0050	0.098**	-0.0060	0.011
	(0.017)	(0.030)	(0.0056)	(0.0051)	(0.047)	(0.039)	(0.030)
Total dependency ratio	0.015	-0.27	-0.13***	-0.076**	-0.067	0.18	0.34*
	(0.083)	(0.17)	(0.036)	(0.031)	(0.22)	(0.21)	(0.17)
Per-capita expenditure quintile 1	0.24	-0.44	-0.039	0.0044	0.49	-1.66**	-1.20***
	(0.25)	(0.51)	(0.14)	(0.12)	(0.68)	(0.66)	(0.44)
Per-capita expenditure quintile 2	0.13	0.26	0.15	0.075	0.36	-1.66**	-0.84*
	(0.26)	(0.53)	(0.15)	(0.13)	(0.68)	(0.66)	(0.45)
Per-capita expenditure quintile 3	0.29	-0.51	0.044	0.076	0.42	-0.55	-0.30
	(0.30)	(0.55)	(0.15)	(0.13)	(0.73)	(0.67)	(0.48)
Per-capita expenditure quintile 4	0.098	0.20	0.031	0.055	0.89	-1.33*	-0.54
	(0.29)	(0.63)	(0.16)	(0.13)	(0.76)	(0.71)	(0.47)
Region: Northern	-0.35*	0.55	0.11	0.23**	0.41	-0.84	-0.055
	(0.20)	(0.65)	(0.14)	(0.11)	(0.86)	(0.88)	(0.62)
Region: Upper East	-0.48	-0.29	-0.0029	0.20*	0.74	0.16	0.64
	(0.32)	(0.81)	(0.15)	(0.12)	(0.98)	(0.98)	(0.71)
Region: Upper West	0	0.55	0.33	0.43**	-0.24	-0.69	-0.34
	(.)	(0.98)	(0.22)	(0.19)	(0.92)	(0.95)	(0.62)
Constant	0.75	4.32	1.99**	1.19*	-0.65	-3.18	0.66
	(1.60)	(3.29)	(0.78)	(0.70)	(4.56)	(3.66)	(3.22)
Observations	84	165	165	165	222	212	227
Adjusted R^2	0.031	0.142	0.166	0.039	0.227	0.089	0.231

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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